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# GROUP SPEECH THERAPY IN INDIVIDUALS WITH PARKINSON DISEASE: FACE-TO-FACE VERSUS TELEMEDICINE

BY

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## Abstract

The purpose of this study was to evaluate the outcomes of group speech therapy for individuals with Parkinson Disease (IWPD) in general and to compare outcomes of group treatment delivered face-to-face (FtF) versus delivery via telemedicine (TM). Twenty-seven IWPD received group treatment based on a modified version of LSVT® in either an FtF or TM format. Outcome measures were collected pre- and post-treatment, which included vocal intensity (dB), *Voice Handicap Index* (*VHI*) scores, and self-ratings. Results indicated that vocal intensity and self-ratings of loudness significantly increased for both the FtF and TM groups. *VHI* scores and the five remaining self-ratings were not significantly improved for either group following treatment, although the data on all measures from the FtF group did show improvement. The findings of this study support the short-term effectiveness of FtF and TM group therapy for improving vocal intensity and participant self-ratings of loudness in IWPD.

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# Introduction

Parkinson disease (PD) is a commonly diagnosed progressive neurological disorder that affects the basal ganglia and the substantia nigra in the brain (Hornykiewiez & Kish, 1986). PD involves a loss of nerve cells in the substantia nigra, and subsequently a decrease in production of the neurotransmitter dopamine. An imbalance between dopamine and acetylcholine is believed to be the cause of the motor movements associated with PD. Tremor, bradykinesia, and rigidity are three classic motor symptoms associated with PD (Marsden, 1984). Speech and voice disturbances commonly occur in individuals with PD (IWPD). In the classification scheme of Darley, Aronson, and Brown (1969), these speech and voice changes are categorized as hypokinetic in nature. Hypokinetic dysarthria is characterized primarily by reduced vocal loudness, monotonous speech, variable rate of speech, imprecise articulation, reduced stress patterns, and a harsh or breathy vocal quality (Canter, 1963).

There is no known cure for PD, although there are treatments to alleviate symptoms. Pharmacological treatment of PD is common. In general, PD medications involve the use of dopamine replenishment, dopamine receptor agonists, dopamine breakdown inhibitors, or anticholinergic drugs (Yorkston, Miller, & Strand, 2004). Whereas pharmacological treatments have been used successfully to manage the limb manifestations of PD, studies have indicated mixed results regarding improvement of PD-related speech symptoms (Brumlik et al., 1964; Cahill et al., 1998; Critchley, 1981; Gallena, Smith, Zeffiro, & Ludlow, 2001; Larson, Ramig, & Scherer, 1994;

Poluha, Teulings, & Brookshire, 1998; Sanabria et al., 2001; Schultz & Grant, 2000; Shea, Drummond, Metzer, & Krueger, 1993; Solomon & Hixon, 1993; Stewart et al., 1995).

Surgical treatments also have been developed to alleviate the symptoms of PD. There are three main categories of surgical treatment including lesioning procedures, nondestructive or augmentative procedures, and restorative techniques (Rascol et al., 2003). To date, there are mixed results of the efficacy of these surgeries for the treatment of Parkinsonian dyskinesias and motor fluctuations (Goetz, Poewe, Rascole, & Sampaio, 2005). In addition, some studies have reported a worsening of speech symptoms following surgical treatment for PD in some patients (Allan, Turner, & Gadea-Ciria, 1966; Jenkins, 1968; Koller, Pahwa, Lyons, & Albanese, 1999; Matsumoto, Asano, Baba, Miyamoto, & Ohmoto, 1976; Parkin et al., 2002).

In addition to treatment options aimed at alleviating the symptoms of PD in general, treatments specifically targeted at improving voice and speech also have been proposed. Surgical procedures that target voice quality and loudness changes in PD include type I thyroplasty, arytenoid adduction, and vocal fold injection methods (Berke, Gerratt, Kreiman, & Jackson, 1999; Hill, Jankovic, Vuong, & Donovan, 2003). Although these surgical procedures can be helpful for IWPD, they are not ideal. They are invasive and often do not have lasting effects on the voice given the progressive nature of PD.

Behavioral speech treatment also has been used as a method for reducing the speech and voice disturbances associated with PD; however, until the 1990s, many

believed that behavioral speech treatment was only marginally effective for IWPD because treatment often did not carry over from the clinic into the natural environment (Weiner & Singer, 1989). A variety of therapeutic devices to improve communication also have been attempted, including pacing boards, voice amplifiers, Delayed Auditory Feedback (DAF) and other masking devices, and biofeedback (Schultz & Grant, 2000); however, these devices may be inconvenient and generalization of results to situations in which the devices are not used may not readily occur.

Speech-language pathologists (SLPs) have attempted to directly train increased vocal loudness, more precise articulation, and greater pitch and loudness variability, among other parameters (Schultz & Grant, 2000). To date, most SLPs generally consider the Lee Silverman Voice Treatment® (LSVT®) to be the most promising method for improving the communication of individuals with hypokinetic dysarthria associated with PD (Yorkston, Spencer, & Duffy, 2003). LSVT® is an intense treatment option that focuses on increasing the volume of the voice through multiple repetitions of speech stimuli using increased effort from the vocal and respiratory systems (Fox, Morrison, Ramig, & Sapir, 2002). LSVT® has been demonstrated to have positive effects on vocal loudness (Ramig, Sapir, Fox, & Countryman, 2001c). Additionally, LSVT® also has been shown to have positive effects on other aspects of speech including articulation and a variety of phonatory measures beyond just intensity and vocal quality even though the therapy focuses solely on increasing loudness (Baumgartner, Sapir, & Ramig, 2001; Dromey, Ramig,

& Johnson, 1995; Smith, Ramig, Dromey, Perez, & Samandari, 1995). Although studies have demonstrated positive outcomes from LSVT®, the time-intensive nature of the program and the need for qualified personnel to deliver the service imposes limits on how many IWPD receive the therapy. Even the developers of the LSVT® program have recognized the need to explore other methods of delivering the service or altering its frequency to make LSVT® more available to those who need it (Spielman, Ramig, Mahler, Halpern, & Gavin, 2007).

Group therapy is one possible means of increasing the availability of speech-language pathology services to improve the voice in IWPD. Group therapy has been utilized successfully across a range of communication disorders in the field of speech-language pathology (de Angelis et al., 1997; Elman & Bernstein-Ellis, 1999a; Elman & Bernstein-Ellis, 1999b; Goldblum, Mulder, & von Gruenewaldt, 2001; Heydebrand, Mauze, Tye-Murry, Binzer, & Skinner, 2005; Robertson & Thomson, 1984; Simberg, Sala, Tuomainen, Sellman, & Ronnemaa, 2006; Williams & Dugan, 2002). Despite documented successes using group speech or language treatment, the group approach may not be universally successful across disorders or treatment foci. At present, there are only three reports describing group voice treatment specifically for IWPD (de Angelis et al., 1997; Robertson & Thompson, 1984; Sullivan, Brune, & Beukelman, 1996).

Another approach to service delivery that may allow increased access by IWPD to behavioral voice treatment capitalizes on advances in telemedicine. With the use of telemedicine, more individuals can potentially receive diagnostic and

therapeutic services from an SLP. Whereas telemedicine initially began as a telephone call between a client and a clinician, the use of telemedicine in the field of speech-language pathology has grown substantially to include audio and video interfacing between client and clinician (Baron, Hatfield, & Georgeadis, 2005). Today, telemedicine has been incorporated into clinical practice across a range of communication disorders and has been utilized for both evaluation and therapeutic purposes (Duffy, Werven, & Aronson, 1997; Hill et al., 2006; Mashima et al., 2003; Sicotte, Lehoux, Fortier-Blanc, & Leblanc, 2003; Theodoros et al., 2006; Theodoros, Russell, Hill, Cahill, & Clark, 2003). To date, there has been only one report regarding the use of telemedicine for SLP service delivery to IWPD who are interested in improving their voice (Theodoros et al., 2006).

Advances in telemedicine and greater use and acceptance of group therapy within the field of speech-language pathology have occurred over the past decade. Although there is well documented success of LSVT® with IWPD, there are limitations that restrict patient access to the therapy. This study evaluated a therapeutic intervention with IWPD that utilized group therapy, telemedicine service delivery, and principles for improving vocal loudness currently utilized in LSVT®. The literature reviewed below covers issues regarding group therapy, telemedicine, and voice therapy for IWPD. An overview of PD, treatment options available (both those for general control of PD symptoms and those specific to voice issues), limitations to current behavioral treatment in this area, and attempts at increasing access to SLP services by using group therapy and telemedicine are reviewed.

# Literature Review

## *Overview of Parkinson Disease*

Parkinson disease (PD) is a fairly common progressive disease of the central nervous system affecting both cognition and motor control (Yorkston et al., 2004). The disease affects the area of the brain known as the basal ganglia, specifically the pars compacta of the substantia nigra (Hornykiewiez & Kish, 1986). In PD, neurons within the substantia nigra become impaired or die; consequently, the chemical dopamine is no longer produced at normal levels. A balance between dopamine and acetylcholine in this part of the brain is crucial for coordinated function and movement of muscles. The many symptoms of PD begin to develop and emerge when roughly 60% to 70% of the cells that produce dopamine are impaired or die (Lang & Lozano, 1998a).

According to recent estimates ("National Parkinson Foundation," 2007), both men and women are equally affected by PD. There are similar rates of occurrence across countries, socio-economic levels, and ethnicity. Currently within the United States, over 1.5 million Americans are diagnosed with PD. Furthermore, 60,000 new cases are estimated to be diagnosed each year. The average age of onset is 65 years old or older; however, 15% of people diagnosed with PD are diagnosed at age 50 or younger.

PD is classified into one of three etiological groups: 1) idiopathic; 2) secondary or acquired; or 3) Parkinsonism Plus Syndromes (Yorkston et al., 2004). The largest of the three is the idiopathic group. This group contains etiologies of

unknown or spontaneous origin and classification of idiopathic PD is done by a process of excluding other potential causes of the presenting symptoms. The secondary or acquired group contains PD etiologies that result from the use of certain drugs, exposure to specific toxins, or vascular lesions within the brain. The final group, which has the worst prognosis, is labeled Parkinsonism Plus Syndromes (PPS). This is a collective range of disorders with features similar to PD usually resulting in an early misdiagnosis as idiopathic PD. A number of diseases and conditions are grouped under the heading of PPS including, but not limited to progressive supranuclear palsy, corticobasal degeneration, and multi-system atrophy. PPS differs from PD because PPS is not as responsive to pharmacological treatment. Additionally, individuals with PPS show extra signs and symptoms beyond what occur in idiopathic PD.

Despite differences in etiology, the fundamental difficulty that people with PD experience is the impaired ability to automatically perform learned motor functions (Marsden, 1984). There are three classic symptoms that are associated with this inability to perform a learned motor function: tremor, bradykinesia, and rigidity (Yorkston et al., 2004). Tremor occurs in nearly two-thirds of IWPD. It is often the initial symptom of PD and typically begins in the extremities. The tremor occurs at rest (i.e., “resting tremor”) and is suppressed by activity. Bradykinesia is evidenced by a person’s inability to begin or execute intentional sequences of movement. When a movement begins, it is either expressed slowly or rapidly. In the most extreme situation, a movement cannot be initiated at all (i.e., akinesia). Examples of

symptoms of PD that are the result of bradykinesia include reduced facial expression, decreased eye blinking, and reduced swinging of the arms while walking. Lastly, rigidity is evident as an increase in muscle tone throughout the range of movement of a muscle. Additionally, postural instability is also a debilitating symptom of PD that is frequently included as a principal feature of PD in more recent descriptions of the disease. People with PD often have a stooped or bent posture that results in them being prone to fall to one side.

In addition to the debilitating limb and trunk motor characteristics associated with PD, voice and speech impairments are common and can lead to negative impressions of the person with PD (Pitcairn, Clemie, Gray, & Pentland, 1990). The speech and voice of an IWPD is most often categorized as hypokinetic in nature (Darley et al., 1969). Hypokinetic dysarthria in PD is characterized by the following: monopitch, reduced loudness, reduced stress, prosodic changes displayed as inappropriate silences, short rushes of speech and variable rate, imprecise consonants, and a harsh or breathy voice (Canter, 1963; Darley et al., 1969). Hypokinetic dysarthria can affect any one or all speech subsystems (i.e., respiration, phonation, articulation, prosody, or resonance), so there are other speech deficits that can occur beyond the more common ones listed above (Schulz & Grant, 2000).

Hartelius and Svensson (1994) found that 70% of the 258 IWPD in their study self-reported speech and voice changes that they felt were associated with PD. The most debilitating speech or voice problem experienced by 61% of the participants was a weak voice. Although “weak voice” was not explicitly defined, it appeared to be a

reflection of reduced vocal loudness. Other reported speech and voice problems included the following: imprecise articulation (36%); hoarse voice (32%); difficulty getting started (27%); monotonous voice (17%); speech that was too slow (11%); tremor (10%); stuttering (9%); speech that was too fast (6%); impaired stress or rhythm (5%); and voice that was too nasal (4%). The results of this study based solely on patient report should be interpreted cautiously because a considerable number of IWPD lack awareness of their speech difficulties (Coates & Bakheit, 1997). In that case, the data from Hartelius and Svensson (1994) may represent a conservative estimate of the speech and voice problems that actually are present in IWPD.

Logemann, Fisher, Boshes, and Blonsky (1978) investigated signs of vocal dysfunction in 200 patients with PD. They reported that 89% of participants demonstrated signs of vocal change characterized by breathiness, hoarseness, roughness, and tremors. Lingual and/or labial articulation disorders were found in 45% of the patients. Inappropriate speech rates were identified in 20% of participants and 10% of the patients were hypernasal. This study indicates that the speech deficits in PD can occur across speech subsystems and may occur in the vast majority of IWPD.

The phonatory system is commonly affected in PD; therefore, IWPD often experience voice disorders. Fox and Ramig (1997) studied vocal sound pressure levels (SPL) during voice and speech tasks in individuals with idiopathic PD compared to an age-matched control group. The PD group displayed significantly lower (by 2.0-4.0 dB SPL) vocal SPLs than the control group. These authors

concluded that the majority of IWPD experience reduced vocal loudness. Vocal quality can also be affected in IWPD. A breathy vocal quality in PD is the result of an increase in the glottic gap due to incomplete closure of the vocal folds (Perez, Ramig, Smith, & Dromey, 1996). The vocal qualities of hoarseness and roughness also are characteristic in IWPD (Ramig & Gould, 1986). Other vocal difficulties include deficits in vocal initiation and timing of phonation relative to other speech activities.

Articulation also is susceptible to degradation in IWPD. Specifically, imprecise consonant articulation is characteristic of dysarthria associated with PD (Yorkston et al., 2004). Stop consonants are most often affected because they require a great amount of constriction (Ackermann & Ziegler, 1991). Imprecise consonant articulation could be attributed to a reduction in tongue strength and endurance that has been documented for IWPD (Solomon, Robin, & Luschei, 2000). Additionally, rigidity of the orofacial muscles in IWPD may contribute to a failure of the articulators to make necessary contact with the intended articulatory target; this is known as articulatory undershoot.

IWPD also have difficulty precisely controlling the prosody of their speech. Both faster than normal and slower than normal speaking rates have been noted. Fast speaking rates have been described as “rushes of speech” (Netsell, Daniel, & Celesia, 1975). Netsell et al. (1975) reported that some IWPD had speech rates of 13 syllables per second indicating a faster than normal overall speaking rate, where 5.0 syllables per second is considered normal (Kent, Kent, & Rosenbek, 1987). In contrast, Canter (1963) found no significant differences in terms of speaking rates between the IWPD

group and the control group; however, individual differences were noted in terms of a slow rate of speech. The speaking rates of two IWPD were so slow that they were judged abnormal.

The respiratory system of IWPD can be affected. The respiratory pattern of speech in IWPD has been described as rigid (Kim, 1968) presumably due to a rigid chest wall (Solomon & Hixon, 1993). Solomon and Hixon (1993) found that IWPD produced fewer syllables on one breath than a normal control group. IWPD also may demonstrate a reduction in maximum phonation times, perhaps reflecting deficits in both the respiratory as well as the phonatory systems (Mueller, 1971).

Resonance deficits also have been reported for IWPD. Inadequate velopharyngeal closure may lead to the perception of hypernasality in IWPD (Hoodin & Gilbert, 1989); however, hypernasality is a less common speech change in IWPD compared to changes in the other speech subsystems (Schulz & Grant, 2000).

## *Treatment Options Available*

### *General Treatments for PD*

*Pharmacological treatments.* Even though PD is a well-described and frequently diagnosed progressive neurological disease, there is currently no known cure. While the search for a cure continues, researchers and healthcare providers have focused on the management of the symptoms of PD. Pharmacological treatments are the most commonly used approach in this case.

Due to a lack of production of dopamine within the substantia nigra, this results in an imbalance between the dopamine system and the acetylcholine system

(Yorkston et al., 2004). The consequences of the unbalanced systems result in an incoordination of the body's movements in IWPD. Pharmacological interventions have been developed in an attempt to restore a balance between dopaminergic and acetylcholinergic transmitter systems, thus creating a reduction of the PD symptoms. Pharmological intervention has proven to be quite successful for a large number of IWPD, and for that reason, drug regimens remain a primary tool in the management of PD. Drug treatments can be subdivided into dopamine replenishments, dopamine receptor agonists, dopamine breakdown inhibitors, and anticholinergic drugs (Yorkston et al., 2004).

First introduced in 1968, L-dopa has become the preferred dopamine replenishment drug treatment (Schulz & Grant, 2000). L-dopa is an orally administered drug. When a person takes L-dopa, only a small amount of L-dopa crosses the blood-brain barrier and disintegrates into dopamine that is readily absorbed in the brain. Dopamine that is not absorbed in the brain and that is left in the periphery (i.e., the gastrointestinal tract) can cause side effects such as nausea and vomiting (Yorkston et al., 2004). Therefore, L-dopa is routinely given in combination with carbidopa, which prevents metabolism of L-dopa outside of the brain, thus reducing the side effects of L-dopa (and also preserving the length of time that the drug is available for metabolism in the brain). The combination of L-dopa with carbidopa is now prescribed from various companies under the brand names Sinemet®, Paracopa®, and Atamet®. Even with the success of these drugs and drug combinations for alleviating the motor symptoms of PD, side effects still can and do

occur. Side effects include a marked drug cycle of effectiveness, presence of chorea-like movements during peak-dose levels, hallucinations, and vivid dreams.

The positive impacts of L-dopa based drugs on motor function of the limbs are generally recognized. Whether or not these dopamine replenishment drugs are effective at reducing or eliminating speech symptoms of PD is open to debate. Rigrodsky and Morrison (1970) found that speech did improve when patients took L-dopa; however, the changes in speech production were not statistically significant and were not as remarkable as changes in limb and motor function. Others have reported that L-dopa treatment is associated with positive changes to speech. L-dopa administration was shown to improve articulatory functioning, specifically lip movement, during speech and non-speech tasks (Cahill et al., 1998). Significant increases in fundamental frequency and overall vocal motor function in 20 IWPD have been reported by Sanabria et al. (2001). Administration of L-dopa produced a reduction in thyroarytenoid muscle activity in IWPD, which resulted in improvement of voice onset and offset for speech when compared to the non-medicated state (Gallena, Smith, Zeffiro, & Ludlow, 2001).

In contrast to the studies demonstrating a positive change in speech related to L-dopa administration, others have not found a significant change from the medication and still others have raised the possibility of a negative influence on speech from L-dopa drugs. Critchley (1976) reported that he observed several instances of peak-dose dysphonia and aphonia that he felt were induced by L-dopa. More recently, speech breathing was studied across the drug cycle in 14 male subjects

with PD (Solomon & Hixon, 1993). Results of this study indicated that the drug cycle had no significant effect, positive or negative, on speech breathing. Additionally, the effects of the drug cycle on phonatory functioning were studied in two IWPD (Larson, Ramig, & Scherer, 1994). No significant improvements in phonatory function related to L-dopa medication were reported. In another study, acoustic features of vowel production were studied across the drug cycle in 10 subjects with PD, but no significant changes in speech measures as a function of the drug were identified (Poluha, Teulings, & Brookshire, 1998). Given the contrasting findings of both positive and negative effects from the drugs, and findings indicating no improvement in speech when taking L-dopa, a conservative conclusion would be that these drugs cannot be relied on to manage the speech deficits in PD.

Another group of drugs used for the treatment of the symptoms of PD are known as dopamine receptor agonists or dopamine imitators (Yorkston et al., 2004). These drugs seek to mimic, enhance, and prolong the effects of dopamine within the brain. Common drugs available are Parlodel®, Permax®, Requip®, and Mirapex®. Common side effects are similar to those reported for L-dopa. Dopamine agonists have been shown to improve limb motor symptoms associated with PD (Lieberman, Ranhosky, & Korts, 1997). Additionally, there has been some suggestion that Mirapex® may benefit speech by increasing vocal intensity (Schulz, 2002).

Dopamine breakdown inhibitors, more commonly referred to as MAO-B (monoamine oxidase-B) inhibitors, seek to slow the breakdown of dopamine in the brain, thereby prolonging the effects of L-dopa (Yorkston et al., 2004). This group of

drugs includes selegiline, commonly referred to as Deprenyl® or Eldepryl®. In a recent research review, selegiline was found to be non-efficacious in the prevention of dyskinesias in IWPD. In a study focusing on the impact of selegiline on speech, positive effects on respiration for speech and on articulation were noted in 10 subjects with moderate PD (Shea, Drummond, Metzer, & Krueger, 1993). It should be noted that selegiline was taken in addition to the subjects' established drug regimen, which included L-dopa; however, the drug Deprenyl® taken in isolation (i.e., without combining it with L-dopa) did not produce any observable change in voice or articulation in a different study of 10 subjects with PD (Stewart et al., 1995). Another group of dopamine inhibitors is known as catechol-o-methyl transferase (COMT) inhibitors (Yorkston et al., 2004). These drugs extend the life of L-dopa by blocking an enzyme that seeks out and destroys dopamine within the liver and other organs. The drug Tasmar® is included in this category. To date, there are no reports of the effects of COMT inhibitors on speech in IWPD.

The final drug category that is used to help alleviate the symptoms of PD is known as anticholinergic drugs. This drug intervention is the oldest form of pharmacological drug treatment used for PD (Yorkston et al., 2004). Artane®, an anticholinergic drug, was originally introduced in 1950. The aim of anticholinergic drugs is to re-establish the balance between the dopamine system and the acetylcholine system by preventing the action of the acetylcholine (Ach). The aim of Ach drugs is to reduce tremor in the extremities (Schulz & Grant, 2000); however, significant side effects including dry mouth, blurry near-sighted vision, constipation,

and weakening of the bladder have served to discourage widespread use of this drug with the advent of other alternatives such as L-dopa (Yorkston et al., 2004). Speech changes related to Artane® taken for PD management have not been widely investigated. In one study, Artane® was shown to improve speaking rate and speech intensity significantly in IWPD (Brumlik et al., 1964); however, in another investigation, IWPD who were administered anticholinergic drugs showed only occasional improvement in articulation and the changes were not sustained over time (Critchley, 1981).

In summary, some pharmacological treatments for PD have had significant positive impacts on motor functions of the limbs, but these drugs cannot be relied on to eliminate the speech changes that accompany PD. In some studies, positive changes to speech have occurred, but in others there were either non-significant changes or, in rarer circumstances, negative impacts from the medications.

*Surgical treatments.* Before the introduction of effective pharmacological treatments, surgical interventions were the most commonly utilized method for controlling the symptoms of PD (Koller, Pahwa, Lyons, & Albanese, 1999). There are three main categories of surgical intervention available to IWPD: 1) Lesion procedures such as thalamotomy and pallidotomy; 2) Nondestructive or augmentative procedures such as deep brain stimulation (DBS); and 3) Restorative techniques that focus on fetal tissue transplantation or gene therapy (Rascol et al., 2003). To date, there are mixed results regarding the efficacy of these surgeries for the treatment of Parkinsonian dyskinesias and motor fluctuations (Goetz et al., 2005). Additionally,

these surgeries may have negative effects on speech and voice in IWPD (see below for further explanation).

Lesion procedures involve the use of an electric current to destroy a specific area of tissue within the brain that is thought to contribute to PD symptoms (Koller et al., 1999). Thalamotomy involves lesioning the ventrolateral thalamus (Grossman & Hamilton, 1993). This surgical intervention has been successful at reducing tremor and rigidity on the contralateral side of operation (Tasker, Lang, & Lozano, 1997). Additionally, it has been used successfully to treat tremor in IWPD who are currently resistant to the usual drug treatments (Tasker, et al., 1997); however, surgical procedures have been shown to have negative effects on speech in some cases. Unilateral thalamotomy in a person's dominant hemisphere can result in slow speech, monotonous voice, decreased vocal loudness, and articulation difficulties (Allan, Turner, & Gadea-Ciria, 1966; Jenkins, 1968). Bilateral thalamotomy also may negatively affect speech by resulting in word blocks, reduced rate of speech, and hypophonia (Matsumoto, Asano, Baba, Miyamoto, & Ohmoto, 1976). Due to the negative effects of bilateral thalamotomy, this surgical procedure is not usually recommended, particularly when preservation of speech is essential; however, reduced morbidity has occurred in bilateral thalamotomy due to advances in surgical techniques (Koller et al., 1999).

A second lesioning procedure known as pallidotomy involves lesions to the area of the basal ganglia known as the globus pallidus internus (GPi) (Eller & Dan, 1997). Because IWPD have over-activity in the GPi, lesioning of this area creates

inhibition within this area thereby reducing the symptoms of PD. Individuals with mild hypokinetic dysarthria who received unilateral pallidotomy have demonstrated improvements in both phonatory and articulatory aspects of speech (Schulz, Peterson, Sapienza, Greer, & Friedman, 1999). The results suggested that unilateral pallidotomy may improve specific aspects of speech in individuals with mild hypokinetic dysarthria; however, unilateral pallidotomy did not improve the speech characteristics of IWPD who had more severe dysarthria. Bilateral pallidotomy has been associated with adverse effects on speech (Koller et al., 1999; Parkin et al., 2002). As is the case with bilateral thalamotomy, bilateral pallidotomy is rarely recommended due to the adverse effects on swallowing, speech, and cognition.

Another surgical option available for alleviating the symptoms of PD is the nondestructive technique known as DBS. DBS involves the use of a device similar to a pacemaker that is implanted just under the skin in the chest, which sends electrical stimuli through a subcutaneous wire from the chest to an electrode implanted in one of three locations: the thalamus, the subthalamic nucleus (STN), or the GPi (Koller et al., 1999; Rodriguez-Oroz et al., 2005). DBS helps improve limb motor functioning in the majority of cases (Fields & Troster, 2000); however, the impact on speech is less predictable. For example, bilateral DBS stimulation of the STN did decrease dysarthria and improved the force of articulation in 10 people with PD (Gentil, Garcia-Ruiz, Pollak, & Benabid, 1999). In a one-year follow-up study, there was no significant worsening of speech in 17 patients who underwent thalamic DBS surgery (Tarsy et al., 2005); however, in another study, bilateral STN stimulation did not

result in a functional change in speech performance in seven IWPD (Dromey, Kumar, Lang, & Lozano, 2000). A similar finding of no speech improvement following bilateral STN DBS surgery in 46 IWPD also was reported (Zhang et al., 2006). It can be concluded that DBS is generally successful at alleviating limb motor symptoms of PD, but it cannot routinely be relied on for alleviating the speech symptoms of PD; however, these studies suggest hemispheric effects of DBS surgery as unilateral DBS surgery is more effective in improving the speech (e.g., dysarthria, articulation) characteristics of IWPD compared to bilateral DBS surgery. Wang and colleagues (2006) studied speech characteristics before and after unilateral DBS surgery of the subthalamic nucleus in 20 right-handed subjects with advanced stages of PD to determine if there were hemispheric effects on speech. Ten individuals were operated on the right hemisphere and ten individuals were operated on the left hemisphere. Results of the study suggested hemisphere effects on the speech, specifically rate of syllable repetitions and articulatory accuracy, of the participants.

A final surgical option that is new and still considered experimental is fetal tissue transplantation, a restorative surgery. This procedure involves the implantation of fetal dopaminergic cells into the basal ganglia, specifically the putaman or caudate (Wenning et al., 1997). The underlying principle of this technique is that the implanted dopaminergic cells will secrete the neurotransmitter dopamine into the individual's dopamine deficient brain (Kordower, Goetz, Freeman, & Olanow, 1997). One study reported improvements in limb motor tasks in IWPD following fetal tissue transplantation; however, no systematic improvements were found in the areas of

phonation and articulation (Baker, Ramig, Johnson, & Freed, 1997). Currently, this procedure is still considered an experimental technique, and is not a primary approach for alleviating the speech deficits in IWPD.

In summary, the available surgical options have been shown to be viable approaches to reducing the limb motor symptoms associated with PD in the majority of cases; however, these surgical options do not usually improve the speech symptoms associated with PD and in some situations can actually increase the speech deficits. Considering the speech outcomes related to pharmacological as well as surgical treatments of PD, SLPs have sought other alternatives that specifically address the speech and voice symptoms that accompany PD.

*Specific Treatments to Improve Speech in PD*

*Surgical treatments.* Surgical options to improve speech in IWPD include type I thyroplasty, arytenoid adduction, and vocal fold injection methods (Berke et al., 1999; Hill et al., 2003). All of these procedures address the phonatory changes in PD. Both type I thyroplasty and arytenoid adduction increase vocal fold approximation. In the former, a small wedge of Silastic is implanted in the larynx through the thyroid cartilage at the level of the vocal fold, pushing that fold toward midline. The arytenoid adduction procedure involves placing sutures from the muscular process of the arytenoids to the cricoid cartilage. This suture is pulled tight during the procedure to rotate the vocal process of the arytenoid, and subsequently the vocal fold itself, toward midline. Both of these procedures result in a decrease in the glottic gap with the intent of improving vocal quality. In one study, it was reported that 13 out of 15

(87%) IWPD had vocal fold bowing that resulted in incomplete glottic closure during phonation (Blumin, Pcolinsky, & Atkins, 2004). Type I thyroplasty and arytenoid adduction procedures could theoretically assist in obtaining more complete glottic closure for IWPD, and the use has been suggested by some in the medical field; however, formal reports of the outcomes of such an approach have not appeared in the literature.

Injection methods involve the insertion of collagen, gelfoam, or fat directly into the vocal folds to improve glottal closure (Schulz & Grant, 2000). Like the thyroplasty and arytenoid adduction procedures, injection methods were developed for individuals with vocal fold atrophy, vocal fold paralysis, or bowing of the vocal folds. The intent of the injection is to improve vocal quality and intensity. Berke et al. (1999) studied the effects of collagen augmentation on the vocal folds in 35 patients with idiopathic PD who experienced hypophonia. The results of the study showed that collagen augmentation had beneficial effects of increasing vocal loudness and intelligibility. In another study of 12 patients with PD and other parkinsonian disorders who had severe hypophonia, vocal quality, intelligibility, and volume improved following collagen injections into the vocal folds (Hill et al., 2003). A positive finding from injection laryngoplasty for individuals with Parkinsonian hypophonia has also been reported (Sewall, Jiang, & Ford, 2006). Although injection methods have been shown to improve the vocal symptoms associated with PD, these treatments are not ideal because the treatment itself does not usually have lasting effects. Hill and colleagues (2003) reported benefits of collagen injection to last

between 7.8 and 8.5 weeks. This becomes particularly problematic when combined with the fact that as PD progresses, phonatory function often continues to decline, which may necessitate follow-up injections in order to maintain voice improvement.

*Behavioral speech treatments*. Behavioral speech therapy also has been utilized as a method for improving the overall communication of IWPD; however, until the 1990s, it was widely believed that speech therapy was only marginally effective at best and that improvements that did occur did not usually generalize outside the treatment environment (Weiner & Singer, 1989). Between the 1950s and 1970s, many did not believe in the effectiveness of speech intervention for IWPD. In Sarno's (1968) observation of over 300 patients with PD who had speech deficits, her impression was that speech treatment was not beneficial. Although the patients received a variety of speech treatments, Sarno (1968) concluded that even if speech gains were made within the therapy session, these did not carry over into the natural environment. Likewise, Allan (1970) believed that it was impossible to ever discharge IWPD from speech therapy due to the progressive nature of their disease, which prevented them from experiencing carryover outside the therapeutic environment.

A variety of therapeutic devices have been utilized as part of the speech therapy programs, either as a primary means of accomplishing a change in speech or as a supplement to the direct behavioral intervention for individuals with hypokinetic dysarthria (Schulz & Grant, 2000). These devices include the use of a pacing board, a voice amplifier, Delayed Auditory Feedback (DAF), a wearable biofeedback device,

and a speech masking device. A pacing board is a device that is divided into segments. The user moves his/her finger from one segment to another segment at a designated pace and attempts to match his/her speech production to this rate by producing one syllable per finger tap. In one case study, a pacing board successfully helped a severely impaired IWPD to control palilalia, a speech disorder in which parts of speech are repeated numerous times with an increasing rate (Helm, 1979). Pacing boards are not always effective after extended use. The user may develop a pattern of progressively more rapid tapping on the pacing board which is no longer effective in slowing the rate of speech. Voice amplification devices help to increase the volume of a person's voice (Schulz & Grant, 2000). It has been suggested that the device may help individuals monitor their speech and consequently aid in improved speech intelligibility (Greene & Watson, 1968). A limitation of voice amplification devices includes amplification of imprecise articulation, a common speech characteristic of IWPD. Although potentially effective, both pacing boards and voice amplifiers are additional objects that an individual must physically carry with them to aid speech, limiting their convenience.

DAF devices have been used with IWPD in an attempt to improve overall speech intelligibility. A DAF device allows users to hear though headphones what they said ~0.2 seconds after they speak (Silverman, 2004). This auditory delay causes the user to speak at a slower rate, thus improving speech intelligibility in IWPD. With the use of a portable, body-worn device, speech intelligibility was shown to dramatically improve in two out of 11 subjects with PD (Downie, Low, & Lindsey,

1981). When the device was in use, these two subjects improved their speech intelligibility by reducing the rate of speech, increasing the amount of fluent speech, and increasing volume; however, it should be noted that the portable DAF device produced no benefits to the other nine subjects involved in the study. Additionally, the DAF device had to be used constantly to have any effect on the individual's speech. There are no others studies of DAF devices for use with IWPD.

A single case study reported the use of a wearable biofeedback device to assist an IWPD in generalizing vocal loudness outside of the clinic setting (Rubow & Swift, 1985). The device sounded an alarm if vocal loudness dropped below a certain threshold. Measures that were taken pre- and post-treatment showed generalization of treatment behaviors into his daily life while wearing the device. Specifically, measures of loudness, monotonous pitch, rate, stress, distortions of vowels, and irregular articulatory breakdowns showed improvement; however, like other devices, a wearable biofeedback device may physically be an inconvenience to use in normal daily living.

A final therapeutic device that has been incorporated into therapy for IWPD involves the use of a portable masking device. The device is based on the "Lombard effect" where most individuals will increase the loudness level of their voice in the presence of masking noise (Adams & Lang, 1992). In 10 out of 10 IWPD who initially had low vocal intensity, it was reported that dramatic improvements in vocal loudness were demonstrated while speaking with the masking noise compared to speaking without the masking noise. Rate of speech and speech intelligibility were

not positively affected. Additionally, no generalization was reported for use when not wearing the device.

Therapeutic devices for speech treatment in IWPD have been reviewed by the Academy of Neurologic Communication Disorders and Sciences (ANCDS; Yorkston, Spencer, & Duffy, 2003). The review focused on behavioral techniques utilized in respiratory and phonatory treatment of dysarthria. Results suggested that therapeutic devices can be effective treatment options to help increase loudness and intelligibility in individuals with dysarthria; however, results should be interpreted with caution due to the small number of subjects involved in the review.

Although some therapeutic devices have been shown to have positive effects on the speech of IWPD, widespread use has not occurred principally because of the inconvenience of having to use the device continually in order to achieve speech gains; therefore, over the years SLPs have sought other behavioral approaches that do not rely on external devices. These other approaches have focused on altering prosody, respiration, articulation, and voice (Schulz & Grant, 2000). Currently, most of the speech-related research on IWPD, and the trend clinically, is to focus on increasing loudness (e.g., Lee Silverman Voice Treatment®; see below for more details); however, other speech treatments have been attempted.

It should be noted that a review of speech and language therapy for dysarthria in IWPD was recently completed by The Cochrane Collaboration (Deane, Whurr, Playford, Ben-Shlomo, & Clarke, 2001). This review revealed only three randomized controlled trials involving treatment of dysarthria in IWPD. Due to the small number

of studies included in the review, it was determined that "there is insufficient evidence to support or refute the efficacy of speech and language therapy for dysarthria in Parkinson's disease" (Deane et al., 2001, p. 9). Regardless of the results of the Cochrane review, behaviorally based speech treatment strategies have long been used for speech intervention in IWPD.

One of the first behavioral speech treatments focused on respiration (Erb, 1973). Classes were held that emphasized speech and non-speech breathing exercises. The classes involved three IWPD and were held for 20 to 30 minutes three times weekly. All three individuals improved their intelligibility, but improvements were inconsistent over an unspecified amount of time. More recently, respiratory treatment that focused on increasing lung volume and subglottic air pressure for speech in 19 IWPD produced statistically significant increases in SPL during reading and perceptual self-ratings of loudness (Ramig, Countryman, Thompson, & Horii, 1995). Using another respiratory treatment approach, statistically significant increases in vocal intensity were found, but the increase was not maintained 12 months post-treatment (Ramig, Countryman, O'Brien, Hoehn, & Thompson, 1996). Additionally, one other study did not show significant improvement in vocal quality in IWPD who completed a respiratory based therapy approach (Baumgartner, Sapir, & Ramig, 2001). Interestingly, Smith, Ramig, Dromey and Samandari (1995) reported a decrease of 1.9 dB SPL from pre- to post-treatment for individuals completing a respiratory based treatment program. Overall, behavioral respiratory treatment has been attempted with mixed results in IWPD.

Behavioral management of respiratory and phonatory dysfunction in individuals with dysarthria (not specifically restricted to IWPD) has been reviewed by the ANCDS (Spencer, Yorkston, & Duffy, 2003). According to this review, there is evidence-based support for treatment of respiratory and phonatory dysfunction in dysarthria. Evidence-based treatment is targeted through improving respiratory support for speech; increasing control and coordination of respiration and phonation; and improving the overall functioning of the phonatory system. Although this evidence does not specifically target IWPD, the evidence is relevant because dysarthria is common in IWPD.

Additional behavioral speech treatments have focused on improving the prosodic aspects of speech in IWPD. Scott and Caird (1983) focused on maximizing prosody in 26 patients with PD who received one-hour treatment sessions five times a week for two to three weeks. Treatment also involved the use of a visual reinforcement device, a light source that was voice-operated, that allowed the user to self-monitor aspects of speech prosody. Subjects did significantly improve their speech in terms of prosody and intelligibility; however, the visual reinforcement device appeared to only benefit those patients with severe speech disorders. Results of the improvement tended to regress, but some residual benefit was maintained up to three months.

Johnson and Pring (1990) also focused on prosodic aspects of speech, namely pitch and loudness, but used a less intense therapy schedule than Scott and Caird (1983). Six subjects with idiopathic PD received 10 one-hour treatment sessions over

the course of four weeks. At the end of the treatment period, both pitch and loudness parameters of speech had improved significantly suggesting that less intensive speech treatment can be effective for IWPD. No follow-up measures were taken; therefore, it is unclear whether maintenance of these gains occurred.

Prosody also was the main behavioral therapeutic approach for a single case study of one IWPD with hypokinetic dysarthria (Le Dorze, Dionne, Ryalls, Julien, & Ouellet, 1992). Rate of speech, mean fundamental frequency, and intonation were assessed. Following auditory and visual biofeedback treatment, all three aspects of prosody showed improvements. The subject's prosody was considered more normal with greater speech intelligibility. These improvements were maintained at a 10-week follow-up assessment.

Treatment of dysarthria through prosodic interventions was recently reviewed by the ANCDS (Yorkston, Hakel, Beukelman, & Fager, 2007). A review of 10 articles, with 32 total subjects, focused on treatment of dysarthria through improved intonation, rhythm, or rate. Results of the review suggested that adequate conclusions regarding treatment of dysarthria through prosodic interventions could not effectively be made due to the small number of studies assessed.

*Behavioral speech treatments: Lee Silverman Voice Treatment®.* The current focus of most SLPs working with IWPD focuses on increasing vocal loudness using an intensive treatment regimen. The most researched behavioral therapy of this kind is known as the Lee Silverman Voice Treatment® (LSVT®). The main objective of the treatment is to train increased loudness that will in turn increase respiratory drive

and increase laryngeal musculature functioning (Fox et al., 2002). There are five main concepts of the LSVT® treatment method: 1) Exclusive focus on the voice and vocal loudness; 2) Use of high-effort productions with numerous repetitions; 3) Intense treatment schedule of four therapy sessions (50-60 minutes each), four times a week for four weeks in a row with homework to be completed each day (therapy and non-therapy days); 4) Enhance sensory awareness of increased vocal loudness and increased vocal effort; and, 5) Measurement of vocal behaviors.

In order to assess whether the outcomes of LSVT® treatment were treatment-specific, LSVT® treatment in individuals with idiopathic PD was compared to two other control groups who did not receive speech or voice therapy: 1) IWPD; and 2) Individuals who were neurologically normal who did not have speech or voice disturbances (Ramig et al., 2001c). Results indicated no significant difference in vocal loudness from pre- to post-treatment for individuals in either of the untreated control groups, but significantly increased vocal loudness for those completing LSVT®. On average, the LSVT® treated participants had an 8 dB increase in loudness. Vocal loudness was maintained at a six-month follow-up exam. In an earlier study, Ramig et al. (1996) had documented significant improvements in vocal loudness following LSVT® that were maintained for 12 months in a group of 35 individuals with idiopathic PD. Twelve-month retention of loudness gains from LSVT® was subsequently confirmed by Sapir et al. (2002). In this study, improvement in quality of voice also was maintained at the 12- month follow-up.

Retention of increases in vocal loudness and pitch inflection following LSVT® also has been reported (Ramig et al., 2001b).

LSVT® has been compared to respiratory-focused treatment. Ramig and Dromey (1996) studied the aerodynamic aspects of vocal functioning in a group of 45 individuals with idiopathic PD. Individuals underwent either LSVT® in combination with respiratory treatment or respiratory only treatment. Individuals who received the LSVT® and respiratory combination treatment achieved an average increase of 14 dB SPL due to increased subglottic air pressure and improved vocal fold adduction. In contrast, individuals who received the respiratory treatment alone displayed an average decrease of 2.3 dB SPL. Ramig, Countryman, Thompson and Horii (1995) randomly assigned 45 individuals with idiopathic PD to either a respiratory or a voice and respiratory (LSVT®) treatment group. Results indicated that LSVT® was more effective than respiratory only treatment. The LSVT® group increased SPL in vowels by an average of 13.96 dB in males and 9.89 dB in females compared to the respiratory only treatment group where females increased SPL by an average of 1.99 dB and males decreased SPL by an average of 3.23 dB. Overall, LSVT® appears to be an effective means of voice intensity treatment for IWPD (Trail et al., 2005).

In addition to improvements in voice intensity, LSVT® may have carryover effects on aspects of speech beyond phonation. In a case study of an individual with early-stage idiopathic PD, the LSVT® approach not only resulted in increased loudness, but also improved articulation even though articulation was not specifically targeted in therapy (Dromey, Ramig, & Johnson, 1995). Specifically, louder

phonation led to improvement in articulation as evidenced by increased second formant transitions, increased vowel duration, and greater jaw displacement, all of which were interpreted as having a positive impact on the speech of the subjects. The changes in vocal intensity and articulation were maintained at six- and twelve-month follow-up exams.

Smith et al. (1995) used laryngostroboscopic examinations to assess phonation with individuals who received LSVT®. Twenty-two subjects with idiopathic PD were randomly assigned to either an intensive combination of voice and respiratory treatment (i.e., LSVT®) or a respiratory only treatment. Those completing the LSVT® group demonstrated more complete glottal closure during phonation and a greater increase in vocal loudness during the production of /i/ compared to the respiratory only treatment. Although the authors did not focus on vocal quality, an improvement in glottal adduction would be expected to result in improved vocal quality (i.e., reduced breathy quality, if indeed, that was present). In a more recent study, LSVT® was compared to respiratory effort treatment to examine the effects on hoarseness and breathiness in 20 IWPD (Baumgartner et al., 2001). Two expert listeners, both of whom were speech-language pathologists, perceptually rated the degree of hoarseness and breathiness from voice recordings of oral reading. The results of the study indicated a significant reduction in both hoarseness and breathiness for individuals who received LSVT®. Overall, LSVT® appears to have widespread effects on speech that extend beyond increased vocal loudness and to increase speech intelligibility. According to the World Health Organization model,

LSVT® has been shown to have positive effects beyond the impairment level and extends to the activity/participation level (World Health Organization, 2001).

The impact of LSVT® on swallowing disorders associated with PD has also been considered (El Sharkawi et al., 2002). Eight individuals with idiopathic PD had their swallow evaluated before and after LSVT®. The results of the study were promising in that both tongue coordination and lateralization during chewing and swallowing were improved following LSVT®. Additionally, delay in triggering the pharyngeal swallow while drinking also was improved. Perhaps the most promising result of the study was that the characteristic "tongue pumping" associated with PD disappeared on all but the largest bolus volumes following LSVT® treatment in all subjects who demonstrated this behavior pre-LSVT®. This resulted in a reduction in oral transit time. The findings suggested that the neuromuscular control of the oral and pharyngeal phases, specifically the tongue and base of tongue, may be improved through LSVT®.

IWPD often are described as having a masked-like facial expression (Rinn, 1984). LSVT® treatment also has been shown to have positive effects on facial expressiveness in IWPD (Spielman, Borod, & Ramig, 2003). This retrospective study evaluated video samples from 44 individuals with idiopathic PD. All individuals received LSVT® from a certified LSVT® therapist. Facial mobility (i.e., facial muscle activity) and facial engagement (i.e., general communicative effectiveness) were evaluated. The combination of these variables allowed for the evaluation of facial expressiveness. Facial mobility and engagement were evaluated before and

after LSVT® treatment from video tapes using a five-point scale where "1" represented minimally mobile/engaged and "5" represented extremely mobile/engaged. Observers' ratings indicated more facial mobility and greater engagement following treatment. This suggested that LSVT® may be an effective approach to increase facial expressiveness in IWPD.

An ANCDS literature review of 16 studies involving LSVT® treatment in IWPD was conducted by Yorkston and colleagues (2003). Results of the review suggested that LSVT® treatment produces direct post-treatment gains. Additionally, it was suggested that there are indications for maintenance effects of LSVT® treatment in IWPD.

In addition to the beneficial effects of LSVT® with IWPD, LSVT® also has been applied to a variety of other neurological disorders (Fox et al., 2006). The LSVT® approach has shown positive outcomes with the speech deficits associated with Parkinsonism plus syndromes (Countryman, Ramig, & Pawlas, 1994). Vocal loudness and vocal quality also were improved in select individuals with multiple sclerosis (Sapir et al., 2001) and cerebellar ataxia (Sapir et al., 2003). In addition to the benefits of LSVT® with the elderly population, LSVT® also has been applied to the pediatric population (Fox et al., 2006). Children with Down syndrome and cerebral palsy were documented to exhibit improved vocal quality, vocal loudness, and articulatory precision. These studies provide preliminary data suggesting that training to improve vocal loudness through LSVT® can have beneficial effects on the speech systems of persons with neurological conditions other than PD.

Voice and speech improvements for IWPD who receive LSVT® have now been documented over multiple studies for a decade; however, there are aspects of LSVT® that impose restrictions on its use and availability. Initially, SLPs must undergo specific training from the developers of the LSVT® program. Once the training is successfully completed, the SLP can then advertise him/herself as a certified LSVT® therapist and can deliver LSVT® to individuals. The LSVT® training and certification require a financial and time commitment on the part of the SLP. This may contribute to the lack of certified LSVT® SLPs in some parts of the country and the world. This may be particularly true in rural settings that are further away from large cities where LSVT® training workshops are most likely to occur. Even when there are certified therapists available, other barriers exist that may limit how many patients receive the treatment. LSVT® requires an intensive time commitment from both the SLP and the patient. For many practicing SLPs, scheduling a patient for this amount of therapy is difficult unless they are in a situation where they routinely have time set aside on a daily basis for LSVT® therapy. From the patient's perspective there may be a number of issues regarding the intense therapy schedule. For example, they may not be able to do the prescribed regimen if they are currently working or have other commitments each day, live some distance from the SLP, or rely on others to transport them to therapy. Cognitive deficits that can accompany PD (Yorkston et al., 2004) also may pose some challenges to successful completion of LSVT® therapy that at least require a rescaling of expected therapy outcomes (Trail et al., 2005).

These limitations have prompted many SLPs, including the developers of LSVT®, to search for modifications of the program in order for it to be more accessible. Spielman and colleagues (2007) have examined an extended version of LSVT® that they refer to as LSVT®-X. Twelve individuals with idiopathic PD received two one-hour sessions of treatment weekly for eight successive weeks. The total face-to-face time between the patient and the SLP was equal between traditional LSVT® and LSVT®-X. The main difference between the two was the amount of home practice, which was significantly increased for LSVT®-X. Additionally, the amount of time between treatment sessions was doubled in LSVT®-X. The results indicated that individuals who underwent LSVT®-X did have a statistically significant increase in vocal loudness that was comparable to traditional LSVT®.

The issue of treatment delivery scheduling in order to reduce some of the limitations of LSVT® also has been investigated (Wohlert, 2004). Eleven individuals with hypokinetic dysarthria secondary to PD were assigned to participate in one of three treatment groups with varying treatment delivery schedules: four times weekly for one month, two times weekly for two months, or two times weekly for one month. Treatment focused on increasing vocal loudness and followed the guidelines of LSVT® except for the schedule of treatment. All participants were assigned the same number of homework sessions. Results of the study showed that every participant displayed an increase in vocal loudness while reading a passage. These results were reduced at a three-month follow-up for all participants except one, but were higher than pre-treatment measures. The schedule of treatment did not have an effect on the

outcomes of the treatment. This suggested that different LSVT® schedules may have immediate positive outcomes. Issues regarding retention of the loudness gains over time for individuals completing the voice treatment on less intense schedules need to be investigated in more detail.

Recent advances in technology have helped reduce some of the limitations of LSVT® while still providing the recommended schedule of treatment (Halpern et al., 2004). A device known as the LSVT® Companion (LSVT®-C) is a personal digital assistant (PDA) that is specially designed to administer LSVT® treatment at a person's home on the same schedule as would be done in face-to-face LSVT® therapy with an SLP. The PDA also collects data that can be used in tracking progress over time. Another device known as the LSVT® Virtual Therapist is a computer-based device that acts as a surrogate therapist based on live clinical models (Cole, Ramig, Yan, Halpern, & Van Vuuren, 2004). The IWPD sits in front of a computer screen that displays an animated virtual therapist providing instruction and feedback for daily completion of therapy activities. Both the LSVT®-C and LSVT® Virtual Therapist are still under development, and data-based assessments of their effectiveness are not yet available. Neither of the devices is intended to replace an LSVT® therapist; thus, their aim is to help alleviate some of the limitations imposed on the strict schedule of LSVT® treatment.

LSVT® is considered the gold standard for treatment of voice issues in IWPD given the strong evidence base reported in the literature. Modifications to this program are being attempted by the developers of the program to increase treatment

accessibility. Additional considerations for delivery of voice therapy to IWPD drawn from other areas of speech-language pathology also may provide attractive service delivery alternatives. These include the use of group therapy and the use of telemedicine technology, or a combination of the two.

## *Methods to Increase Access to Speech Treatment*

### *Group Treatment*

The use of group treatment within the field of speech-language pathology is not new. Initially, the use of group speech treatment arose out of the need for SLP services following World War II (Baron et al., 2005). As the number of soldiers who returned home from war with closed-head injuries increased, the number of clinicians available to provide service was insufficient; therefore, group therapy sessions were implemented as a way to provide speech therapy to those in need.

Over the last 50-60 years, SLPs have used group treatment approaches across a wide range of communication disorders. Although significantly more research is needed regarding the use of a group approach for each of the specific communication disorder groups discussed below, the body of literature across disorder types generally appears to support the position that group therapy can be an effective mode of service delivery.

The group approach has been used regularly with adults who have aphasia. Elman and Bernstein-Ellis (1999a) studied the efficacy of group treatment in 24 individuals with chronic aphasia. Participants were randomly assigned to an immediate treatment group or a deferred treatment group. Individuals received five

hours of group treatment weekly for four months. Group therapy focused on initiating conversation and exchange of information through any means possible. The results of the study suggested that group communication treatment in individuals with chronic aphasia is efficacious. Specifically, the individuals who received immediate group treatment had significantly higher post-treatment scores on the Western Aphasia Battery- Aphasia Quotient (WAB AQ; Kertesz, 1982) and the Shortened Porch Index of Communicative Abilities (SPICA; Disimoni, Keith, & Darley, 1980) than individuals in the deferred treatment group. Other studies of group aphasia treatment also have demonstrated positive language outcomes (Brumfitt & Sheeran, 1997; Wertz et al., 1981). Additionally, group treatment for individuals with aphasia also has been shown to result in positive psychosocial changes (Elman & Bertnstein-Ellis, 1999b). These psychosocial changes included beneficial support of others with aphasia and improved language abilities.

Group therapy also has been utilized in the treatment of adults (Boberg, 1976) and children who stutter (Williams & Dugan, 2002). Stuttering modification treatment might be offered in this type of setting as well as psychosocial support. Group treatment creates a friendly environment that may motivate children and adults by observing the success of their peers. It also allows participants to see others with a shared experience.

Individuals who have sustained a closed head injury (CHI) also have benefited from group treatment (Goldblum, Mulder, & von Gruenewaldt, 2001). A five-year study was conducted with six individuals with a CHI who participated in a

conversational group for at least two years. The results of the study indicated that individuals who participated in the conversational group reported improvements in overall quality of life, increases in life participation, improved self-confidence, and increased assertiveness. Although additional study is needed, these results suggest that group therapy may have value for individuals with CHI.

Group speech therapy also has benefited adults who have received cochlear implants (CI) (Heydebrand, Mauze, Tye-Murray, Binzer, & Skinner, 2005). A study was conducted with 33 adults who received CIs. Group intervention was conducted over a two-day program with a follow-up session one month later. Group intervention focused on improving overall communicative functioning and improving coping skills. The results of the study suggested that adults who received CIs and participated in group therapy enhanced their communicative functioning and improved their coping skills. Participants reported that following group intervention, they experienced fewer conversational breakdowns and felt less discouraged.

Voice therapy also has been provided in group settings. In one report, 40 student teachers with mild voice disorders were enrolled for study (Simberg, Sala, Tuomainen, Sellman, & Ronnemaa, 2006). Twenty students received voice therapy; 20 students did not receive voice therapy and served as the control group. Those receiving treatment attended voice group therapy for an hour and a half once a week for seven weeks. There were three small groups that consisted of six to eight members. The results indicated that students involved in the treatment group displayed significant improvement in vocal quality as compared to the students who

received no treatment. These results suggested that group voice therapy is an effective therapeutic method for treatment of mild voice disorders. Similar beneficial results of group voice therapy have been reported (Carding, Horsley, & Docherty, 1999).

Group voice therapy also has been implemented with IWPD (de Angelis et al., 1997). Twenty IWPD attended 13 group voice therapy sessions over the course of one month. Voice therapy focused on increasing vocal intensity with groups of five individuals per session. After a month of voice group therapy, all participants demonstrated an increase in vocal intensity. All participants self-reported that others could understand them better following completion of group voice therapy, suggesting that speech intelligibility or audibility had increased. There also was a marked decrease in monotonous speech, suggesting more variability in speech intonation. Additionally, there was a decrease in strained-strangled vocal quality. In another study of voice group treatment, 12 IWPD received an intensive form of group voice treatment over the course of two weeks (Robertson & Thomson, 1984). Therapy focused on respiration, vocal production (with focus on loudness and variation of pitch), articulation, rate of speech, variation of intonation, and overall speech intelligibility. Although the authors did not report details, they indicated that there were improvements in respiration, phonation, articulation, prosody, swallowing, facial expressiveness, and overall speech intelligibility. These results were reportedly maintained for up to three months. Although further study is needed, these two

reports indicate that group voice therapy may result in improvements in voice and communication for IWPD.

Sullivan and colleagues (1996) also utilized group speech treatment with IWPD. Six IWPD with hypokinetic dysarthria participated in group speech intervention to improve speech intelligibility. Treatment was addressed through increased voice projection and increased breath support. Perceptual judgments of loudness, appropriate pitch, and vocal tone were assessed. Results of the study suggested that group speech treatment was effective in improving speech intelligibility for five of the six participants. Additionally, these results were maintained for up to 10 months following intervention.

Group treatment studies for IWPD with dysarthria have been reviewed by the ANCDS (Yorkston et al., 2003). Reports have shown success at the impairment and activity/participation levels; however, the interventions were not easily duplicated and aspects of psychometric adequacy were less than sufficient. Therefore, it should be noted that ANCDS concluded that there was insufficient evidence of the effectiveness of group treatment for IWPD with dysarthria.

Despite the ANCDS recommendations, group treatment offers potential advantages over individual therapy, which makes it an attractive consideration for delivering voice therapy to IWPD. One obvious advantage is that the SLP may be able to offer the therapy to more clients at a given time, which may partially help to alleviate issues regarding availability of SLP services in some locales. Group therapy may be a cost-effective way to provide services in comparison to traditional, one-on-

one therapy sessions (Elman & Bernstein-Ellis, 1999a). Group treatments, depending on how they are structured, may also have other features that are beneficial for IWPD, not the least of which is the opportunity to interact and perhaps derive support from others with a shared experience. Additionally, group therapy might encourage a more natural communication exchange, which would help in generalization of targeted communication behaviors.

Despite the potentially positive aspects of group communication treatment with IWPD, there also are some limitations. Group communication treatment requires a central meeting place where the SLP is located. The greatest limitation to group communication treatment is the proximity of IWPD to the SLP providing service. If individuals are not able to attend therapy at the central meeting location, this limits the number of individuals served. This becomes a significant possibility when trying to provide services to older adults with a progressive neurological disease such as PD, which can impose restrictions on mobility and driving (Spielman et al., 2007). If there is not an SLP within close proximity to the IWPD, the individual is then forced to do without speech therapy or travel to the nearest service provider. In rural areas of the United States, this may be a heavy burden on many IWPD that limits the number of individuals served.

*Telemedicine*

According to the American Speech-Language-Hearing Association (2005a), telepractice (i.e., telemedicine) is an appropriate delivery model for diagnostic and treatment services provided by speech-language pathologists. Telemedicine

technology provides a possible solution to the problem of patient access to SLP services. The use of telemedicine within the medical community has been acknowledged for over 25 years (Baron et al., 2005). Telemedicine initially began as a telephone-only communication between a clinician and a client, but has since evolved into more sophisticated means of connecting healthcare providers and patients (Burgess et al., 1999). Today, telemedicine is delivered through three distinct models (American Speech-Language-Hearing Association, 2005b). The store-and-forward model is the most commonly used form of telemedicine. It is the electronic transmission of data from one location to another through a telephone modem, a fax machine, or the internet. The clinician interactive model traditionally requires an interaction of the client and clinician; however, the client and clinician do not have to be in the same location. This model is accomplished through interactive videoconferencing. The final telemedicine model is the self-monitoring/testing model. This model is mainly used by clients with chronic illnesses and requires the client to collect and forward data to the clinician. Delivery of telemedicine is also available through various devices including the telephone, videophones, closed circuit televisions, computers with web cameras, image scanners, and various other apparatuses.

Speech-language pathologists also have explored the use of telemedicine for diagnostic and therapeutic purposes across a range of communication disorders. The use of telemedicine for diagnostic services and evaluations conducted by SLPs has been investigated (Duffy, Werven, & Aronson, 1997). Eight patients with a wide

variety of speech and language disorders received diagnostic services via satellite consultation. The evaluations consisted of an oral mechanism examination, a motor speech examination, and a language examination. The patients were evaluated by a clinician via satellite and also by an on-site clinician to ensure reliability of the satellite consultations. The authors also reviewed an additional 24 previously recorded videotaped samples of individuals with a variety of speech and language disorders who had been evaluated via satellite. Furthermore, the results of another 150 telemedicine evaluations were retrospectively examined to help identify potential problems with the use of telemedicine for the purpose of evaluating and diagnosing speech and language problems. The results of the satellite consultations showed a 96% agreement in diagnosis between the on-site clinician and the satellite clinician. Patient satisfaction was high. Results of the retrospective telemedicine evaluations show that in only 13% of the cases (19 patients), a definite diagnosis could not be made. The authors interpreted the results of the study as an indication that telemedicine evaluations were a reliable and beneficial method of diagnostic services for use with patients with a wide variety of speech and language concerns.

Telemedicine diagnostic services also have been implemented with specific subgroups of speech and language disorders. A study of 10 individuals with dysarthria resulting from an acquired brain injury compared evaluation results from two different assessments: a face-to-face assessment and an online internet assessment (Theodoros et al., 2003). Each assessment was conducted by a different SLP. The results of the study demonstrated a 90% agreement level between the two

different assessment environments for ratings of dysarthria severity. The authors interpreted this as supportive of the conclusion that there is good agreement between FtF assessment and online assessment of dysarthria. In a similar study, 19 individuals with dysarthria resulting from an acquired neurological disorder were assessed through an internet-based telerehabilitation system and through a traditional FtF assessment by two different SLPs (Hill et al., 2006). The results suggested that assessment of motor speech disorders can be reliably completed via an internet-based telerehabilitation system.

Individuals with voice disorders have benefited from telemedicine diagnostic services (Moran, Reilly, de Chazal, & Lacy, 2006). A telephone-based assessment for diagnosis of vocal fold pathology was developed. Fifty-six neuromuscular disordered voice samples and 54 normal voice samples (producing the vowel /a/) were transmitted over the telephone to an ENT surgeon for assessment. Results showed that the sustained phonation could be correctly classified as either normal or as a neuromuscular disorder with 89.1% accuracy. Results of the study suggested that a telephone diagnostic system of voice disorders is a practical option for voice assessments.

Speech-language pathology telemedicine diagnostic evaluations also have been completed in other large-scale telemedicine projects involving teams of healthcare professionals (Lemaire, Boudrias, & Greene, 2001). A low-bandwidth, internet-based videoconferencing system was used over a period of 21 months for consultations with 27 male clients and 40 female clients. A variety of healthcare

professions, including podiatry, nursing, medicine, occupational therapy, prosthetics, physiotherapy, social work, orthotics, and speech pathology, participated in the consultations. SLPs participated in 20% of these consultations for diagnosis of a communication disorder. Twenty-four clients responded to a follow-up questionnaire; all respondents were comfortable with the telemedicine consultation and had confidence in the diagnosis. Although this study was not specific to just speech-language pathology, SLPs were included on the healthcare team in the telemedicine project. The results appear to be supportive of internet videoconferencing for consultations that include the field of speech-language pathology.

Speech and language treatment also has been delivered via telemedicine. One area of treatment that has received attention is fluency. In a study of six children and adolescents who stuttered, participants received fluency therapy via interactive videoconferencing (Sicotte, Lehoux, Fortier-Blanc, & Leblanc, 2003). The participants received individual therapy for one-hour sessions over the course of 12 weeks with all therapy delivered through interactive videoconferencing. An additional five hours of therapy was given to four out of the six participants. During a six-month maintenance phase, five additional one-hour sessions were conducted with each participant. Overall, fluency was improved for all participants. Additionally, this improvement was maintained at a six-month follow-up exam. The patients also reported positive perceptions of the telemedicine treatment. Kully (2000) also reported positive satisfaction with fluency treatment delivered through a videoconferencing system. An adult male patient with severe developmental

stuttering participated in telehealth sessions. He previously completed a three-week intensive stuttering treatment program. The telehealth sessions were completed two months post-treatment and were completed as follow-up sessions to the intensive stuttering treatment. Both the patient and the clinician reported positive outcomes following the telehealth sessions. The patient reported satisfaction with the telehealth sessions and felt the sessions were effective at providing guidance and feedback.

Treatment of voice disorders through telemedicine has been examined (Mashima et al., 2003). Voice therapy was delivered to 51 patients who presented with vocal nodules, vocal edema, unilateral vocal fold paralysis, or vocal hyperfunction with no laryngeal pathology. Therapy was delivered individually with the clinician and client either in the same room, or in separate rooms with therapy delivered via video teleconferencing. The results of the study showed that there were no significant differences between the two therapy environments when comparing outcome measures related to vocal quality, patient satisfaction, acoustic changes, and change in laryngeal tissues.

Voice treatment for IWPD also has been delivered through telemedicine (Theodoros et al., 2006). Ten individuals with idiopathic PD and hypokinetic dysarthria received traditional LSVT® treatment via an internet-based telerehabilitation application with each participant completing 16 one-hour sessions of individual therapy. The results of the study indicated that participants significantly increased loudness levels by an average of 10.8 dB and increased mean pitch range from 157.8 Hz pre-treatment to 229.5 Hz post-treatment. Additionally, breathy vocal

quality was decreased. There was also an increase in pitch variability (from a mean rating of 2.0 pre-treatment to a mean rating of 1.2 post-treatment) and loudness variability (from a mean rating of 2.3 pre-treatment to a mean rating of 1.3 post-treatment) based on perceptual ratings of speech on a five-point scale (1 = normal to 5 = severe). All patients reported that they were satisfied with the services provided. This study suggests that telemedicine is an effective method for delivering LSVT® treatment to IWPD. Positive outcomes also have been reported when using telemedicine for voice treatment and diagnosis of United States military personnel stationed in the Far East who were audio and video linked to clinicians stationed in Hawaii (Mashima & Holtel, 2005).

Telemedicine has been used in a range of other areas including delivery of pediatric SLP treatment (Forducey, 2006), dysphagia evaluations (Georges & Belz, 2006; Perlman & Witthawaskul, 2002), and speech and language evaluations in brain injured individuals (Brennan, Georgeadis, Baron, & Barker, 2004). In addition to using telemedicine for direct patient care, the use of videoconferencing capabilities has been demonstrated to allow a therapist practicing in a rural setting to consult with other therapists (e.g., speech-language pathologists, occupational therapists and physiotherapists) at a larger medical facility in an attempt to provide the best patient care for complicated cases or when the rural therapist had limited experience or training related to specific clients (Jin, Ishikawa, Sengoku, & Ohyanagi, 2000).

The field of speech-language pathology appears to be making attempts at further incorporating telemedicine technology to allow greater access to services,

particularly for individuals in rural areas, but also for those who are not highly mobile. At present, much of what has appeared in the literature is descriptive in nature to indicate how SLPs have attempted to use telepractice technology (Hill & Theodoros, 2002), with fewer data-based studies on the outcomes of such attempts. Telemedicine is a logical alternative to consider in situations where greater access to SLP services is needed; however, given the nature of the problems that are being addressed, namely that the issues involve speech and communication, it is imperative that the technology allows high quality audio and video transmission and that the use of the technology itself does not substantially disrupt how a user is communicating.

### *Statement of Purpose*

Individuals with hypokinetic dysarthria secondary to PD present with decreased vocal loudness that can significantly interfere with communication. LSVT® has proven to be a successful method for increasing loudness for IWPD; however, there are limitations imposed by LSVT® that makes it inaccessible to many individuals in need of treatment. Utilizing group therapy, rather than individual therapy, may be one means of increasing the number of IWPD who have access to an SLP. The group format also might have other advantages over individual therapy such as the opportunity for psychosocial support and natural opportunities for practicing the behaviors targeted in therapy. However, group therapy is still reliant on an individual patient either having access to an SLP nearby or being willing and able to travel to get the service. Telemedicine offers a means of further addressing the issue of restricted access to SLP services. Combining an adapted version of LSVT®

with group treatment and telemedicine may help maximize the number of IWPD who are able to receive speech services. However, to date, the use of group voice therapy for delivering services to IWPD has received limited attention with only three investigations of which the authors are aware (de Angelis et al., 1997; Robertson & Thomson, 1984; Sullivan, et al., 1996). Even less has been reported on the use of telemedicine to deliver speech services to IWPD (Theodoros et al., 2006). There are currently no studies that compare group speech therapy for IWPD delivered in a traditional face-to-face (FtF) format versus group speech treatment delivered via telemedicine (TM).

The purpose of this study was to compare the outcomes of IWPD who participated in group speech therapy delivered in a traditional FtF format to group speech therapy delivered through TM. The specific questions addressed in this study were:

1) Was group speech treatment effective for improving the communication of IWPD? Specifically, following completion of the group therapy:
    a. Was there a pre- to post-treatment difference in vocal intensity? The hypothesis was that increases would be found for vocal intensity as measured by mean dB SPL.
    b. Was there a pre- to post-treatment difference in participant self-ratings of loudness, vocal tremor, hoarseness, monotony, intelligibility, and participation in conversation? The hypothesis was that participants would rate themselves as louder, less tremorous, less hoarse, less

monotonous, more intelligible, and more willing to participate in conversation following completion of the group therapy.

c. Was there a difference in the degree of voice handicap that participants experience as determined by self-report on the *Voice Handicap Index (VHI)* compared to their pre-treatment score on the *VHI*? The hypothesis was that the difference in pre- and post-treatment scores on the *VHI* would reflect a lessening of the perceived handicap related to their voice.

2) Was there a difference in the outcomes for group speech treatment delivered in a traditional FtF format compared to TM? More specifically:

   a. Was there a difference in the pre- to post-treatment changes in vocal intensity of speech when comparing the FtF and the TM groups? The hypothesis was that there would be no difference in the magnitude of change when comparing the two groups.

   b. Was there a difference in the pre- to post-treatment change scores for self-ratings of loudness, hoarseness, vocal tremor, monotony, intelligibility, and participation in conversation when comparing the FtF and the TM groups? The hypothesis was that there would be no difference in the magnitude of change between the two groups.

   c. Was there a difference in the pre- to post-treatment change scores on the *VHI* in the FtF group compared to the TM group? The hypothesis

was that there would be no difference in the magnitude of change between the two groups.

Subjective reports from participants regarding aspects of the groups that they felt were beneficial or not beneficial also were gathered. There was a variety of participant-related variables that were tracked such as age, age at diagnosis, current PD severity level, etc. These were considered when interpreting study results, but given the size of the subject pool, it was not possible to incorporate these into the study design itself.

## Method

*Subjects*

Two groups of IWPD participated in this study. The first group attended a face-to-face (FtF) voice group at the Landon Center on Aging (COA) at the University of Kansas Medical Center (KUMC). This group was led by student clinicians and speech-language pathologists from the KUMC Hearing and Speech Department. Individual participant information regarding gender, age, time since diagnosis, and medications is provided in Table 1. The group consisted of 10 males and six females for a total of 16 subjects. Average age was 70.9 years (sd = 11.7) with an average time since PD diagnosis of 12.6 years (sd = 8.8). Participants were recruited from the KUMC Neurology Department, as well as from healthcare providers in the community and local PD support groups.

The second group of subjects was IWPD who attended voice groups delivered via telemedicine (TM). Biographical and medical information on this group is included in Table 2. This group consisted of one male and 10 females for a total of 11 subjects. Average age was 75.9 years (sd = 11.9) with an average time since PD diagnosis of 13.0 years (sd = 7.5). SLPs from the Hearing and Speech Department at KUMC made arrangements with local contacts in cities within the state of Kansas to provide the voice groups. These groups were conducted with IWPD in Coffeeville, Hays, and Emporia, Kansas. Recruitment for each TM group was completed primarily through local resources that included PD support group personnel in that city/region and also local neurologists. The voice group sessions were led by two

Table 1

*Characteristics of subjects who participated in the Face-to-Face voice group*

| Subject | Sex | Age | Etiology | Years since diagnosis | PD Medications | DBS Surgery |
|---|---|---|---|---|---|---|
| 1 | Male | 83 | PD | 16 | c | No |
| 2 | Male | 66 | PD | 13 | a, b, c, d | Yes |
| 3 | Female | 71 | ~ | 11 | c, f | No |
| 4 | Male | 75 | PD | 15 | b, c | Yes |
| 5 | Male | 82 | PD | 8 | e | No |
| 6 | Female | 82 | PD | 29 | a,c | Yes |
| 7 | Female | 79 | PD | 1 | ~ | No |
| 8 | Male | 65 | PD | 14 | ~ | Yes |
| 9 | Female | 83 | PD | 9 | ~ | No |
| 10 | Male | 56 | PD | 26 | b, c | Yes |
| 11 | Male | 78 | Vascular PD | 7 | ~ | No |
| 12 | Male | 44 | PD | 3 | a, d | No |
| 13 | Male | 64 | PD | 13 | b, d, e, f | No |
| 14 | Female | 64 | PD | 2 | a, e, g | No |
| 15 | Female | 71 | PD | 6 | c, f | No |
| 16 | Male | 71 | PD | 29 | d, e | Yes |
| Summary | Male = 10<br>Female = 6 | Mean = 70.9<br>sd = 11.7 | | Mean = 12. 6<br>sd = 8.8 | | Yes = 6<br>No = 10 |

*Note.* All DBS surgeries were bilateral.

a = requip, b = amantadine, c = sinemet, d = stalevo, e = carbidopa-levadopa, f = miraplex, g = lexapro

~ = no response

Table 2

*Characteristics of subjects who participated in the Telemedicine voice group*

| Subject | Sex | Age | Etiology | Years since diagnosis | PD Medications | DBS Surgery |
|---|---|---|---|---|---|---|
| 1 | Female | 71 | PD | 15 | d, f | No |
| 2 | Female | 74 | PD | ~ | a, c | No |
| 3 | Female | 80 | PD | 3 | ~ | No |
| 4 | Female | 81 | PD | 12 | f | No |
| 5 | Female | 74 | PD | 25 | c | No |
| 6 | Female | 73 | PD | 23 | b, c, f | No |
| 7 | Female | 90 | PD | 10 | e, g | No |
| 8 | Male | 87 | PD | 2 | d, f | No |
| 9 | Female | 90 | PD | 10 | e, f | No |
| 10 | Female | 49 | PD | 17 | c, b | Yes |
| 11 | Female | 66 | PD | 13 | a, c | No |
| Summary | Male = 1<br>Female = 10 | Mean = 75.9<br>sd = 11.9 | | Mean = 13.0<br>sd = 7.5 | | Yes = 1<br>No = 10 |

*Note.* All DBS surgeries were bilateral.

a = requip, b = amantadine, c = sinemet, d = stalevo, e = carbidopa-levadopa, f = miraplex, g = lexapro

~ = no response

student clinicians from the Hearing and Speech Department who were supervised by a certified speech-language pathologist in the department.

For both the FtF and TM voice groups, the inclusion and exclusion criteria were identical. The inclusion criteria were as follows:

- Older than 18 years of age. This was dictated by the nature of PD.
- Diagnosis of PD made by a board certified neurologist. Ideally, all participants would have idiopathic PD in order to be enrolled in this study. Historically, however, the KUMC FtF group has been open to IWPD or Parkinsonism with varying etiologies. It would have been ideal to restrict the etiology of PD to help constrain possible influences of etiology on the therapy's effectiveness; however, at this early stage of investigation of group treatment for PD, it was more practical to allow individuals with a range of etiologies to participate in order to increase the number of subjects enrolled in the study. Information on each participant's etiology is provided in Tables 1 and 2.
- Physically able to participate in weekly hour and a half voice group sessions. This included being able to sit for the allotted amount of time, with breaks as needed, while participating in a variety of voice activities that involved increasing vocal loudness and varying pitch. Previous experience in conducting the groups suggested that most individuals are able to participate fully in this type of structured setting regardless of disease severity. This was

the case for all participants in this study. Participants were not excluded if they were in a wheelchair.

- Cognitively able to participate in the voice group. Because cognition was not screened prior to group enrollment, the graduate clinicians conducting the groups and the supervising SLP were vigilant for indications of deficient cognitive functioning for group participation. In rare instances that occurred in the past, it was necessary to counsel an individual out of the group due to poor attention, memory, or other cognitive skills. This was not the case for any participants that were enrolled in this study.
- Native English speakers. This inclusion criterion was screened by participant self-report on a history questionnaire. Observation of participation in the group also indicated that all participants were native speakers of English.

Exclusion criteria are as follows:

- Comorbid diagnosis that could contribute to speech or communication deficits. This included, but was not limited to stroke, Alzheimer's disease, and significant respiratory disease. Participant self-report on a history questionnaire was used to screen for comorbidity.
- Prior surgery that may have altered speech production. This included, but was not limited to resections of facial structures, tongue, pharynx, larynx, or lungs, cardiothoracic surgery with known damage to the recurrent laryngeal nerve, and significant dental procedures. The history questionnaire served to screen for such surgeries.

- Significant hearing loss that was not currently managed with hearing aids or other forms of management. Individuals were not considered for enrollment if his/her hearing loss interfered with the ability to communicate in the voice group. Hearing was not formally screened; however, participant self-report on the history questionnaire was utilized to screen for such hearing troubles. Based on clinical observations by the student clinicians and supervising SLP, hearing issues were not a significant problem for any of the participants in this study. Individuals in each group were observed to use hearing aids to manage their hearing loss. No other assisted listening devices were utilized by any participant.

Gender balance within groups and age matching across groups would have been ideal; however, this study was planned as an assessment of a convenience sample of IWPD who were interested in completing a voice group program. As such, enrollment was not governed by gender, age, or other potentially relevant participant-related variables (e.g., ethnicity/race, disease severity, PD etiology, etc.). Unfortunately, medical records were not available for many of the participants (particularly those in the telemedicine groups), so it was not possible to track overall PD disease or symptom severity.

Written consent was obtained from each participant prior to any data collection. The research team explained the study and provided a written description to each potential subject. Prior to agreeing to participate, each subject was given an ample amount of time to read the consent form and ask questions if needed. An

impartial witness observed this process, which was documented in writing. For the FtF group at KUMC, the consent process took place at the Landon COA. For the TM group(s), one of the research personnel traveled to the host city to obtain consent in person prior to data collection. A total of 14 participants consented to be in the TM group, but three were dropped from the study because they did not attend a minimum of five group sessions. A total of 24 participants consented for the FtF group, but eight were dropped because they did not attend at least five sessions.

*Description of the Voice Groups*

Both the FtF group at KUMC and the TM groups were based upon principles and activities adapted from LSVT®, and as such the focus was on increasing vocal loudness. The groups were not advertised as LSVT® therapy, however, because modifications were made to the schedule and the activities themselves in order to accommodate the group format and telemedicine service delivery. The format and focus of the FtF and the TM groups was held as consistent as possible; however, there were modifications to activities and instructions necessitated by use of the telemedicine technology.

*Face-to-face voice group.* The FtF voice group was a six-week program in which participants met once a week for 90 minutes. The group was led by three graduate student clinicians from the Hearing and Speech Department at KUMC. All student clinicians completed a 90-minute orientation from the supervising SLP that prepared them to lead the group. During this orientation, the student clinicians were presented with a handout informing them of the nature and characteristics of PD. The

focus of the group and the typical group activities utilized to achieve the goals were described. Student clinicians watched a DVD showing examples of previous FtF voice groups so that consistency was maintained in the presentation of the group across semesters. Data for this study were acquired across five different 6-week voice groups that spanned four semesters. The students leading a particular 6-week voice group shifted from semester-to-semester but the supervising SLP was constant. Student clinicians were not LSVT® certified; however, the supervising SLP was. The supervising clinician was present for all sessions and oversaw all aspects of the group. Weekly session plans were generated by the student clinicians and were submitted for final approval by the supervising clinician. See Appendix A for a sample lesson plan.

The group met in a conference room at the Landon COA with participants sitting around three sides of a central table. Family members were allowed to attend the session, but generally sat back from the table and did not actively participate so that focus was given to the IWPD. Water and light snacks were available to all present. A large marker board was at the head of the table and a large screen could be pulled down to allow projecting items from PowerPoint or other software programs. Two student clinicians were present at the head of the table. One student clinician led the group while the second student clinician operated the computer and wrote on the marker board as needed. The third student clinician roamed around the group giving personal feedback to the participants.

During the sessions, group activities were completed that targeted increased loudness with multiple opportunities for responding. At the beginning of the session,

participants were greeted and welcomed. Any questions the participants may have had were brought up at the beginning of the session. Each session followed a specific theme chosen by the student clinicians. All activities for the session were focused around the daily theme (e.g., University of Kansas history, fruits and vegetables, world travel, etc.). The session's first activity consisted of voice warm-up exercises. One student led the group in the warm-up exercises by providing a model that participants imitated as a group. A second student clinician at the marker board kept track of the number of responses that were completed by the group. The first warm-up exercise consisted of 15 repetitions of a sustained /a/ (five-second duration per trial). Ten upward pitch glides from a comfortable to a high pitch were then completed followed by 10 pitch glides downward (middle to low pitch). Both the upward and downward pitch glides were produced by the participants using a loud voice. The warm-ups continued as participants repeated a set of 10 short phrases (e.g., thank you) three times using a loud voice. The warm-up exercises concluded with saying ten sentences (e.g., How was your day?) three times in the loud voice. The functional phrases and sentences were held constant throughout the entire six-week session.

Following the warm-up exercises, six to seven activities that lasted about 10 to 15 minutes each were completed. Throughout the activities, the student clinicians constantly modeled talking in a loud voice and verbally reinforced the participants for using a loud voice. The clinicians also frequently identified when a group or individual response was not produced at the target loudness level. A wide variety of

activities were planned by the student clinicians. Examples of activities included hangman, cross-word puzzles, word scrambles, matching games, sentence completion, individual monologues, etc. During the middle of the session, or after three activities, a re-energizer activity was completed. The re-energizer activity consisted of saying five loud “ahs.” Upon completion of all of the activities, a final energizer activity was completed. The final energizer activity consisted of saying five loud “ahs” and repeating the 10 functional phrases.

Each session was supplemented by a PowerPoint slide show for presentation of the stimulus material. Activities began with the participants speaking in single words, and progressed toward more complex sentences. Each session increased in the complexity of spoken responses required by the participants. Activities targeted functional application for participants. Student clinicians focused on maximizing the response rate for each participating individual. The student clinicians switched responsibilities throughout the session so that one student was not engaging in excessive voice use by leading the entire session. Furthermore, student clinicians were encouraged to maintain a high level of energy.

In addition to the weekly voice group sessions, all participants were given “homework” activities that were to be completed at home on a daily basis. The homework activities were intended to establish a louder voice outside of the voice group environment. The homework was expected to take approximately 30-60 minutes to complete each day.

Not all those IWPD who came to the weekly sessions were enrolled as subjects in this study. That is, enrollment in the group was not restricted to study participants but rather was open to any IWPD. Group size generally ranged from five to fifteen participants. Those IWPD who were enrolled and participated as a research subject did not have to pay the $20 fee that non-study participants were required to pay. The student clinicians were not specifically aware of who agreed to serve as a subject and who did not.

The six-week session was repeated throughout the year. Some IWPD opted to participate in more than one six-week block; however, to be included in this study, a person must not have completed any prior six-week sessions.

*Telemedicine voice group*. The TM voice group was designed to replicate as closely as possible the FtF group. Two student clinicians were assigned to lead the TM group. Paralleling the FtF group, the TM group was scheduled for 90 minutes once a week for six consecutive weeks, and the goal was also to train increased loudness with multiple repetitions.

The TM group was conducted with two student clinicians in one of two rooms equipped to allow a tele-link with the remote site in Kansas. In one of these rooms, the student clinicians sat side by side with a Logitech video camera positioned to capture them within the middle of the visual field of the camera. An omni-directional boundary microphone positioned on the table top was utilized to detect the clinicians' voices. Also on the table top were a laptop computer (Dell Latitude 6160), a visual

presenter (ELMO EV-368), and a switching device that allowed the students to switch what was being projected on the screen at the remote site.

At the remote site where the TM participants were physically present, there was a video screen that displayed whatever item was selected at that moment by the student clinicians. A Logitech video camera and boundary microphone in the room at the remote site allowed the clinicians at KUMC to see and hear the participants. This camera was under the control of the student clinicians at KUMC who used a joystick to pan the camera up/down and left/right, zoom in or out, and adjust focus, if they desired. At each remote site, a person without PD was enlisted to help with a variety of tasks including helping to physically set-up the remote room for each session, positioning and re-positioning participants as needed prior to and during a session, and various other activities (getting water for participants, etc.). The PD participants were arranged in a semicircle or in rows (usually with a table in front of them) so that when the camera was panned out, all participants could be viewed at the same time.

The activities for any given week were identical for the FtF and the TM groups, although some modifications had to be made at times to accommodate the technology and TM format. For example, clinicians were able to supply the necessary items needed to play Bingo for individuals in the FtF voice group, but were not able to supply the items for the TM voice group.

*Overview of Study Design*

All subjects participated in pre-group data collection that involved gathering history, voice recordings, participant self-ratings of their voice and their

communication, and participant report of the degree of voice handicap. Details of the data collection are offered below. The pre-group data collection happened within one-week prior to the start of the voice group. Participants then completed the six-week voice group. Attendance at all six voice group sessions was encouraged. A participant was dropped from the study if he/she missed two or more sessions (i.e., they were allowed to miss one session and still remain in the study). Three individuals who consented to be in the study and attended at least one session were dropped because of two or more missed sessions. Participants also were dropped if they experienced a major change in their PD or general health within the six-week period (this was assessed by participant or family report or inquiry from the supervising SLP if they had concerns from informal observations). No subjects enrolled in the study were dropped because of a change in health status.

*Data Collection: Pre-Group*

*History*. Each participant completed a history form (see Appendix B) that assessed demographics; current employment status; and prior medical, speech, and communication history. The form also addressed the impact of PD on daily functioning. The questionnaire was completed at the time of the pre-data collection. The participants also were allowed to complete the questionnaire at home and return the questionnaire to a member of the research group at the voice group the following week. The form took approximately 10 to 20 minutes to complete. Family members or research personnel were allowed to help the participant complete the form as needed.

*Participant report of voice handicap.* Included with the history questionnaire was a copy of the *Voice Handicap Index* (*VHI; see* Appendix C). The *VHI* is a widely used paper and pencil tool to gauge the degree of handicap an individual is experiencing related to his/her voice. It has been assessed for various types of reliability (= 0.83) and validity (= 0.76; Webb et al., 2007) and is now widely used within the area of voice disorders (Rosen, Murry, Zinn, Zullo, & Sonbolian, 2000), including for IWPD (Sewall et al., 2006; Spielman et al., 2007). It consists of 30 statements (e.g., #1. My voice makes it difficult for people to hear me) with an associated 5-point Likert-type scale (labels: Never, Almost Never, Sometimes, Almost Always, Always). The participant was asked to fill this out at home and bring it back to voice group or to complete it during the pre-data collection if their schedule allowed. The *VHI* took approximately five minutes or less to complete. Family members or research personnel were allowed to assist in the completion of the form as needed.

*Participant self-ratings.* Immediately before starting the voice recordings, participants completed a rating form that asked them about 10 aspects of their voice and communication (see Appendix D). These ratings were completed using a 14 cm visual analog scale (VAS) with anchors given toward the left and right sides of each line. For example, they were asked to indicate how they perceived their own loudness. The investigator instructed them as follows: “I want you to think about how loud your voice is when you talk. Indicate whether you are always loud enough, never loud enough, or somewhere in between by placing a mark somewhere along this line

[point to the VAS line for this item].” The investigator instructed them through each of the 10 ratings using similar instructions. This task took approximately five minutes or less to complete.

*Voice recordings*. Voice recordings were obtained by placing a Shure SM 100 headset microphone on the participant and routing the microphone signal to a portable CD-recorder (Marantz CDR300). The audio signal was recorded onto a CD-R disc at 44k Hz sampling rate. In order to obtain absolute dB SPL values, the headset condenser microphone was calibrated in the following manner per Winholtz and Titze (1997) prior to each subject’s recording session:

1. The headset microphone output was routed to the CD-recorder and the recording input level was set. In order to set the recording input level appropriately, the microphone was placed on the participant’s head with the tip 3 cm away from the corner of the mouth. The subject was asked to count to 20 and read a short passage. The input level was adjusted up or down as needed to obtain a strong recording that avoided overloading the recorder as indicated by observations of the VU meter on the CD-recorder. Once set, the input level was not adjusted for the calibration procedure that follows. Additionally, the input level remained unchanged for the subsequent recording of the speech protocol.
2. The microphone was removed from the speaker’s head and placed on a table. A tone generator was positioned with its output 3 cm away from the tip of the Shure SM 100 microphone.

3. A 400 Hz tone was played from the tone generator. A CM 140 sound level meter positioned 30 cm directly in front of the tone-generator and microphone arrangement (see *Figure I*) was used to measure the dB SPL at that distance.
4. The output level of the tone generator was adjusted so that the CM 140 meter registered 60 dB SPL (using C-weighting and fast-response mode). At that point, the microphone output from the 400 Hz tone was recorded onto a CD via the microphone-CD recorder arrangement. A five-second recording of the 400 Hz tone played at 60 dB was obtained. The tone generator output was then adjusted so that the CM 140 meter registered 70 dB SPL and another five-second recording of the 400 Hz tone was obtained on the CD. In the later acoustic analysis, these reference tones were used to calculate actual dB SPL of the speech recordings obtained for a given speaker.

The speech recording itself then proceeded as follows. The participant was seated comfortably in a quiet clinic room (the same room in which the calibration procedure was completed) with the headset in position. All participants completed the speech recording in the order outlined below.

1. Reading Passage: The participants read the *Grandfather Passage* as printed in large font on a sheet of paper. They were allowed to read the passage silently to themselves prior to the recording in an attempt to limit reading errors. They

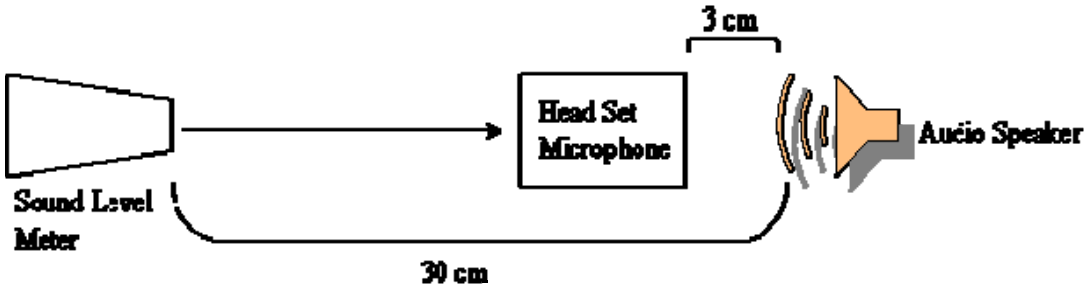


*Figure 1*. Calibration arrangement.

were instructed to read the passage using their "talking" voice at a comfortable pitch, loudness, and rate.

2. Monologue: The investigator instructed participants as follows: "I need to listen to you talk for about a minute without me interrupting you. I'll give you a topic and you can tell me about it using your usual talking voice." The investigator chose a topic from a list of alternatives and offered that to the participant (e.g., What did/do you do for living? Tell about your hometown, etc.).

Sustained vowel and pitch range recordings also were obtained during this session but were not analyzed for this study for two reasons. There was some difficulty with overloading the microphone-recorder arrangement when participants did the sustained vowel (i.e., the audio recording was clipped because the gain was too high). That is, with the recorder input level set during calibration procedures using counting and reading, no overload occurred; however, several subjects then produced sustained vowels at levels that overloaded the recorder. Additionally, the reading and monologue productions would seem to be a closer approximation than sustained vowels to what an individual might typically do in terms of speech.

*Data Collection: Post-Group*

Within two weeks of completing the voice group, participants underwent post-group data collection. They completed the *VHI*, participant self-ratings, and voice recordings in a manner identical to that described above. In addition, they completed a post-therapy questionnaire (see Appendix E) that asked them to indicate their

thoughts on the effectiveness of the group, those aspects of the group that they liked or disliked, and so forth. The intent was to gather subjective comments from the participants that may help in the interpretation of results and may help in the redesign of the groups in the future.

*Measures*

There are three categories of outcome measures that were compared within subjects to identify changes from before to after completing the voice group. The categories are:

1. Intensity (dB SPL): Visi-Pitch IV Model 3950 was utilized to obtain measures of mean dB SPL from the *Grandfather Passage* and the monologue. The audio files on the CD recording from each participant was "ripped" from the CD using Diamond Cut 6 software (DC6 v.6.04) and saved as .wav files. Visi-Pitch IV was then used to open each .wav file at 44.4k Hz. Using the cursor marking capabilities within Visi-Pitch IV, the speech samples of interest were bracketed for analysis as described below.
    a. *Grandfather Passage*: The full reading passage was displayed within the Diamond Cut 6 environment for editing of the waveform to remove pauses. Some IWPD presented with increased numbers and duration of pauses which lowered the mean dB if the pauses were allowed to remain in the sample. The intent was to compare dB during speech production itself. A pause was defined as any segment of the acoustic wave greater than 50 msec that was not a stop gap (i.e., stop

gaps of any length were allowed to remain in the analysis because they were part of the consonant being produced). Once the pauses were removed, the edited passage was saved and analyzed in a manner similar to the sustained vowel. All sentences of the passage were included in this analysis.

b. Monologue: A 30-second monologue was analyzed. The monologue waveform was displayed in the Diamond Cut 6 environment. Pauses were removed as described above. With pauses removed, the first five seconds of the monologue was deleted and the next 30 seconds of the waveform was bracketed for analysis as described above.

In order to obtain an absolute dB value, the calibration tone recorded on the CD for a given speaker also was inputted into the Visi-Pitch IV environment. The middle two seconds of the 60 dB and the middle two seconds of the 70 dB calibration tones were analyzed using the "Energy" function as was done for each of the three samples above. The dB mean calculated by Visi-Pitch IV for the 60 dB and the 70 dB tones, respectively, was logged. A conversion factor was calculated to allow adjustment of the dB reading output from Visi-Pitch IV to be converted to an absolute dB value relative to the 60 and 70 dB calibration tones.

2. Participant Self-Ratings of Voice and Communication: Digital calipers were used to measure the distance from the left edge of the VAS line for a given scale item to the slash mark on the line made by the participant. This distance was measured in mm to the nearest hundredth and recorded as an indication of

a participant's rating for that item. Ratings ranged from 0 mm to 140 mm with a rating toward 0 mm indicating less impairment and a desired response. In total, there are 10 VAS ratings obtained from each participant pre-group and 10 post-group; however, only six of these rating were used for analysis purposes (loudness, tremor, hoarseness, monotony, intelligibility, and participation). In a prior study, these six had been identified as ones that were likely to be more sensitive to changes after completing the voice group.

3. *Voice Handicap Index*: The *VHI* Total score (TOTAL) was used in this study. TOTAL scores were calculated by summing the numerical values marked for each of the 30 items in the tool so that TOTAL scores could range from 0 to 120 (i.e., "never" = 0, "almost never" = 1, "sometimes" = 2, "almost always" = 3, and "always" = 4). A score of 0 would reflect no handicap related to the voice, with increasing score values reflecting increasing perception of voice handicap. Three subscale scores, referred to as the Physical Scale (P-Scale), the Functional Scale (F-Scale), and the Emotional Scale (E-Scale), also can be calculated from the *VHI*. These are simply the sum total of distinct sets of items on the *VHI* tool. For this study, only the TOTAL score was analyzed as the intent was to use the *VHI* to measure more global changes in handicap related to the voice.

*Statistical Considerations*

This study was intended to assess changes that occurred within a participant as a function of having completed a six-week voice group and also to compare changes

across the FtF and TM formats. The first research question asked whether participating in a voice group had an effect on the person in terms of his/her voice, while the second focused on differences pre- and post-group as a function of which group they were in (FtF vs. TM). Rather than completing separate pre-post statistical tests for all variables for each of the two questions, which would unduly increase the number of tests run (thereby increasing the chance of Type I errors), a more conservative solution utilizing analysis of variance (ANOVA) was adopted. There were nine dependent variables of interest (dB for Reading, dB for Monologue, six self-ratings, and one *VHI* score). To assess the dB data, a 2 (GROUP: FtF v. TM) x 2 (TIME: Pre v. Post) x 2 (TASK: Reading v. Monologue) ANOVA with subject as a repeated measure for the Time variable was calculated. For the other seven dependent variables, separate 2 (GROUP: FtF v. TM) x 2 (TIME: Pre v. Post) ANOVAs were computed. By evaluating the main effects of TIME, the first research question could be addressed (i.e., is there any difference in the various dependent variables from Pre to Post-therapy). By evaluating the GROUP and the GROUP x TIME interaction effects, the second research question could be addressed (i.e., are there differential effects on the variables of interest as a function of which group therapy they completed). The ANOVA for the dB data required the third level (TASK) to evaluate whether the stimulus recorded (reading vs. monologue) was of importance.

Given the number of statistical tests run, a more conservative alpha level than the traditional $p = .05$ was used to determine statistical significance. Sharing a .05 alpha level across the eight ANOVAs resulted in an adjusted alpha level of 0.006

(0.05/8) that was used as the criterion for statistical significance for any one ANOVA test.

SPSS 15.0 was used for all statistical procedures. Descriptive statistics were calculated for each of the variables of interest, for individual groups as appropriate, or for the full set of participants.

# Results

*Vocal intensity*

Means and standard deviations for vocal intensity (dB) during reading and monologue are presented in Table 3. The Group x Time x Task ANOVA resulted in a main effect of Time (see Table 4 for the full set of ANOVA results). Inspection of the mean dB values (groups combined and task combined) indicated that intensity was significantly higher post-treatment (69.92 dB) compared to pre-treatment (64.88 dB). The 5.04 dB change represented a 7.8% increase from the pre-treatment dB level. The main effect of Task also was statistically significant. The reading condition had a higher dB value than the monologue, regardless of group or time. The main effect of Group was not statistically significant. This indicated that dB did not differ between the FtF and TM groups in either the pre- or the post-treatment conditions for either reading or monologue. The FtF group demonstrated a 5.16 dB increase and the TM group demonstrated a 4.88 dB increase post-treatment (combining data for reading and monologue). None of the interaction effects were statistically significant.

*Self-ratings*

Group means and standard deviations for the six self-ratings are presented in Table 5. This table also includes the percent change in each parameter from pre- to post-treatment, combining data from both groups. Smaller values for a given parameter reflect less impairment. The results of the series of six Group x Time ANOVAs are offered in Table 6.

Table 3

*Vocal intensity means and standard deviations (SD) by group and task*

| | | Face-to-Face | | Telemedicine | | FtF & TM Combined | |
|---|---|---|---|---|---|---|---|
| | | Pre | Post | Pre | Post | Pre | Post |
| Reading | | | | | | | |
| | Mean | 66.41 | 72.37 | 65.43 | 70.72 | 66.01 | 71.70 |
| | SD | 2.70 | 5.27 | 3.58 | 3.29 | 3.06 | 4.57 |
| Monologue | | | | | | | |
| | Mean | 62.91 | 67.27 | 64.95 | 69.42 | 63.74 | 68.14 |
| | SD | 3.10 | 5.85 | 4.12 | 6.50 | 3.63 | 6.10 |
| Reading & Monologue Combined | Mean | 64.66 | 69.82 | 65.19 | 70.07 | 64.88 | 69.92 |
| | SD | 3.37 | 6.06 | 3.78 | 5.08 | 3.51 | 5.63 |

Table 4

*Group x Time x Task ANOVA results for vocal intensity (dB)*

| | F-Value | Probability | Partial Eta Squared |
|---|---|---|---|
| Group | 0.198 | 0.658 | 0.002 |
| **Time** | **32.641** | **0.000** | **0.246** |
| **Task** | **8.726** | **0.004** | **0.080** |
| Group x Time | 0.026 | 0.873 | 0.000 |
| Group x Task | 3.783 | 0.055 | 0.036 |
| Time x Task | 0.475 | 0.492 | 0.005 |
| Group x Time x Task | 0.048 | 0.828 | 0.000 |

Table 5

*Descriptive statistics for the six self-ratings (SD = standard deviation)*

| Parameter | | Face-to-Face | | Telemedicine | | FtF & TM Combined | | |
|---|---|---|---|---|---|---|---|---|
| | | Pre | Post | Pre | Post | Pre | Post | % Change |
| Loudness | Mean | 86.94 | 60.06 | 70.40 | 59.73 | 80.58 | 59.93 | 25.63% |
| | SD | 23.13 | 21.67 | 22.31 | 20.42 | 23.82 | 20.77 | |
| Hoarseness | Mean | 65.81 | 43.44 | 34.60 | 51.27 | 53.81 | 46.63 | 13.34% |
| | SD | 30.92 | 33.08 | 32.61 | 19.47 | 34.59 | 28.15 | |
| Intelligibility | Mean | 87.63 | 64.69 | 48.90 | 64.45 | 72.73 | 64.59 | 11.19% |
| | SD | 21.82 | 26.72 | 33.81 | 24.74 | 32.65 | 25.44 | |
| Monotony | Mean | 67.63 | 42.63 | 44.70 | 41.00 | 58.81 | 41.96 | 28.65% |
| | SD | 34.12 | 33.69 | 35.72 | 28.75 | 35.88 | 31.20 | |
| Participation | Mean | 67.81 | 49.69 | 40.60 | 53.91 | 57.35 | 51.41 | 10.36% |
| | SD | 34.55 | 32.31 | 36.65 | 26.44 | 37.18 | 28.59 | |
| Tremor | Mean | 47.73 | 37.63 | 55.40 | 47.27 | 50.80 | 41.56 | 18.19% |
| | SD | 30.67 | 30.92 | 27.78 | 19.94 | 29.20 | 26.98 | |

Table 6

*Group x Time ANOVA results for the six self-ratings*

| Parameter | | F-Value | Probability | Partial Eta Squared |
|---|---|---|---|---|
| **Loudness** | Group | 0.198 | 0.658 | 0.002 |
| | **Time** | 32.641 | **0.000** | 0.246 |
| | Group x Time | 0.026 | 0.873 | 0.000 |
| Hoarseness | Group | 1.921 | 0.172 | 0.038 |
| | Time | 0.114 | 0.737 | 0.002 |
| | Group x Time | 5.360 | 0.025 | 0.099 |
| Intelligibility | Group | 6.872 | 0.012 | 0.123 |
| | Time | 0.247 | 0.622 | 0.005 |
| | Group x Time | 6.709 | 0.013 | 0.120 |
| Monotony | Group | 1.723 | 0.195 | 0.034 |
| | Time | 2.355 | 0.131 | 0.046 |
| | Group x Time | 1.297 | 0.260 | 0.026 |
| Participation | Group | 1.557 | 0.218 | 0.031 |
| | Time | 0.068 | 0.795 | 0.001 |
| | Group x Time | 2.911 | 0.094 | 0.056 |
| Tremor | Group | 1.170 | 0.285 | 0.024 |
| | Time | 1.297 | 0.260 | 0.026 |
| | Group x Time | 0.015 | 0.902 | 0.000 |

For loudness, there was a statistically significant main effect of Time, but not Group. Inspection of the pre- and post-treatment mean ratings for loudness indicated that the groups rated themselves as significantly louder post-treatment with an overall change of 25.63% on the VAS. The non-significant Group main effect suggested that the FtF and TM groups did not differ in their pre- or their post-treatment loudness ratings. The Group x Time interaction effect was not statistically significant.

Neither the Group nor the Time main effect was statistically significant for the tremor ratings despite an overall 18.19% improvement for the two groups combined. The interaction effect was not statistically significant.

For hoarseness ratings, the Group and the Time main effects were not statistically significant. Combining the data for the two groups, there was a 13.34% improvement in hoarseness ratings. Although the Group main effect was not significant, it is noted that the FtF group ratings indicated an improvement in hoarseness while the TM group ratings indicated a worsening. The large degree of variability in the ratings (reflected in the standard deviations) presumably prevented the group difference from being statistically significant. The interaction effect was not statistically significant.

Monotony self-ratings did not differ as a function of Group or Time as indicated by non-significant main effects in the ANOVA. Inspection of the means indicated that there was a trend for improvement in monotony ratings (~28% change for the better on this parameter). Based on the pre- and post-treatment mean ratings per speaker group, the trend for improvement in monotony was due principally to

changes in the ratings from the FtF group (changed from a mean rating of ~68 to 43), and not the TM group (changed from 45 to 41). The interaction effect was not statistically significant.

Ratings of intelligibility also did not change as a function of either Group or Time. There was an overall 11.19% improvement in intelligibility ratings when combining data across groups. As with the hoarseness ratings, however, there was a difference in the direction of change in ratings for the FtF and the TM groups. The FtF subjects' ratings went from ~88 to ~65 (or a 23mm change indicating improved intelligibility post-treatment). Conversely, the TM group ratings went from ~49 to ~64 (a 15 point change indicating worse intelligibility post-treatment). Although these changes per group are in opposite directions, neither the Group nor the Group x Time interaction was statistically significant, again presumably because of the large degree of variability in ratings across subjects in both groups.

Finally, for participation in conversation, the main effects of Group and Time, and the interaction effect were not significant. Combining data for the two groups, there was a 10.66% improvement in participation ratings; however, as with ratings of hoarseness and intelligibility, the FtF group had mean ratings reflecting an improvement in participation while the TM group's ratings indicated a worsening.

Overall, the only statistically significant finding for the participant self-ratings was the main effect of Time for the loudness parameter. Subjects rated themselves as louder following treatment. Although there were not other statistically significant main or interaction effects for any of the other self-ratings, there appeared to be a

trend for greater percent change for the better in the group mean ratings by the FtF subjects compared to the TM subjects. For three of the six scales (hoarseness, intelligibility, and participation), the TM group actually had post-treatment group mean ratings that suggested the TM subjects perceived themselves as worse after the treatment. Table 7 summarizes the mean percent changes per group for the six self-ratings as a means of highlighting these differences between groups.

*VHI Total Score*

Means and standard deviations for *VHI* Total score are presented in Table 8. The Group x Time ANOVA resulted in non-significant main effects of Group ($F$=7.165, $p$=.010, partial eta squared = .128) and Time ($F$=1.420, $p$=.239, partial eta squared =.028); the interaction effect also was not significant ($F$=1.637, $p$=.207, partial eta squared =.032). Overall, the *VHI* Total score had a 20.71% change from pre- to post-treatment when data from both groups was combined and the change reflected a perception of less voice-related handicap following treatment; however, inspection of the mean *VHI* scores per group before and after treatment revealed that the FtF group had a notable 28% (but non-significant) improvement in *VHI* score, while the TM group mean scores were essentially unchanged pre- to post-treatment. A lack of statistical power as indicated by the small partial eta squared value is one possible reason for the non-significant main effect of Group.

Table 7

*Mean percent change from pre- to post-treatment on measures of self-ratings by group*

| Self-Rating Measures | Face-to-Face | Telemedicine |
|---|---|---|
| | % Change | % Change |
| Loudness | 25.80% | 15.16% |
| Tremor | 21.16% | 14.68% |
| Hoarseness | 33.99% | -48.18% |
| Monotony | 36.97% | 8.28% |
| Intelligibility | 26.18% | -31.80% |
| Participation | 26.72% | -32.78% |

Table 8

*Descriptive statistics of VHI Total score*
*(SD = standard deviation)*

| Group | | Pre | Post | % Change |
|---|---|---|---|---|
| Face-to-Face | Mean | 51.31 | 37.00 | 27.89% |
| | SD | 22.03 | 20.65 | |
| Telemedicine | Mean | 28.40 | 28.91 | -1.80% |
| | SD | 20.36 | 18.45 | |
| Combined | Mean | 42.50 | 33.70 | 20.71% |
| | SD | 23.87 | 19.83 | |

## Discussion

The purpose of this study was to compare the outcomes of IWPD who participated in group speech therapy delivered in a traditional FtF format to group speech therapy delivered through TM. The study specifically focused on whether group speech treatment was effective for improving the communication of IWPD and whether there was a difference in outcomes between the FtF group and the TM group. Vocal intensity; participant self-ratings of voice, speech, and communication; and perceived handicap related to the voice as reflected by *VHI* scores were the outcome measures of interest.

### *Pre- to Post-Treatment Change in Vocal Intensity*

Vocal intensity was increased at the post-treatment recording for both the FtF and the TM groups. This finding supports the short-term effectiveness of the voice intervention for improving vocal intensity in IWPD. Overall, vocal intensity was increased by ~5 dB when combining data from both groups and both speech tasks (reading and monologue). de Angelis et al. (1997) also have documented a significant increase in dB for IWPD who complete group voice therapy (FtF), but the magnitude of the dB increase was not reported. Greater increases in dB than found in the current study have been reported for IWPD who complete LSVT®. For example, Ramig and colleagues noted an 8 dB increase for 14 people with PD after completing LSVT® (Ramig et al., 2001c). Ramig and Dromey (1996) found an even greater dB change of 14 dB, on average, for 10 people with PD who completed LSVT®. The treatment program completed in these prior studies was standard LSVT®, which follows a

more intense schedule of therapy (one-hour per day, four days a week, four weeks in a row) and a greater total number of treatment sessions and treatment minutes (16 sessions totaling 960 minutes) compared to the program in the current study (1.5 hours per day, one day a week, six weeks in a row, six total sessions, and 540 total minutes). It may be that the reduction in treatment frequency and treatment minutes are important factors that have an impact on the magnitude of the dB change that can be expected for IWPD engaged in speech therapy.

One of the principal reasons cited by the LSVT® developers for its success is the intensity of the treatment schedule. Recently, Spielman et al. (2007) explored an altered LSVT® therapy schedule in recognition of the difficulty that a sizeable number of IWPD have in completing the prescribed regimen. Spielman et al. (2007) had 12 IWPD complete LSVT-X, a treatment program that paralleled LSVT®, but was administered in 60-minute sessions twice a week for eight weeks. The group demonstrated an 8 dB increase at the end of the treatment and maintained an approximate 7 dB increase six months later. The authors interpreted these findings as support for the notion that the LSVT® treatment dose could potentially be altered (i.e., spread out) and still result in a dB increase. Spielman et al. were cautious in stating that replication of their findings with additional subjects is needed before the efficacy of LSVT-X is strongly established. The group therapy regimen described in the current study could be considered an even greater reduction in the intensity of traditional LSVT® than what was described by Spielman et al., and this less intense group alternative may result in a smaller dB increase. Future studies that specifically

assess group treatment dosage will be needed to establish the relationship between group treatment frequency and intensity and outcome measures such as dB.

The fact that both the FtF and the TM groups had comparable increases in dB post-treatment is an important finding. The use of TM to deliver speech and voice services is not new; however, this study represents the first attempt of which the author is aware of that TM has been utilized for group therapy for IWPD. The ability of an IWPD to access speech services may be restricted for a variety of reasons, including issues with mobility and driving as well as geographic distance from SLPs qualified to deliver the service. The fact that the 11 subjects in the TM voice group in the current study had a similar dB increase as the FtF group provides some preliminary support for using TM to broaden access to SLP services for IWPD, at least if the goal is to increase vocal intensity. Theodoros et al. (2006) also utilized TM to deliver voice therapy to IWPD, noting a mean increase of 10.9 dB following treatment, but the therapy was done individually (following LSVT®), not in a group.

The dB increases in this study were noted in a standard reading passage and a prompted monologue. There was no attempt to document the participant's dB in more spontaneous situations, either in the clinic or at the participant's home. As such, it cannot be definitively stated that the dB increase is maintained outside of the clinic or the recording situation; however, based on both written and verbal feedback from participants and their significant others, there were subjective reports of louder voice use in functional situations from participants in both the FtF and TM groups. On the post-treatment questionnaire completed by the participants, 12 of 16 FtF participants

(75%) reported that others had made comments related to positive improvements in loudness. In the TM group, seven of 11 participants (63%) offered similar comments. Additionally, family members have verbally recounted situations or stories with the SLP supervisors suggesting that at least some participants have incorporated a louder voice into their daily life. For example, the daughter of one TM participant described several situations in the home setting where the IWPD used a loud enough voice that it could be heard throughout the house. Another reported that a cafeteria worker at the nursing home where she lived specifically commented on her voice and how "understandable" her speech was compared to prior interactions between the two (before starting the group intervention).

*Pre- to Post-Treatment Changes in Participant Self-Ratings*

Only one of the six participant self-ratings of voice and communication changed significantly following completion of the voice group. Loudness ratings were significantly improved across both groups at the post-treatment data collection. This was not overly surprising considering that the dB data indicated that as a group, the participants did have an increase in their actual intensity. An additional, or perhaps alternative, explanation for the loudness rating change is that, via participation in the groups, the participants repeatedly heard the student clinicians talk about increasing the loudness level of their voice. This singular focus of the voice group was intentionally verbalized within the group setting and feedback during the sessions focused almost solely on vocal loudness. It may be that the participants internalized this focus (in fact, that was the goal), and even if there was not an

associated increase in dB, they may have rated themselves as louder knowing that was the intended goal. At this time, confirmation of an increase in perceived loudness by independent listeners has not been obtained for the current set of participants. Such information will be important as another means of judging the group voice treatment outcomes. Archived recordings from pre- and post-treatment data collection are available and plans are underway to gather the listener data.

Participants rated several other aspects of their speech and communication besides loudness. While loudness is perhaps the most obvious parameter to have subjects rate because it is the primary focus of the group, reports about LSVT® have suggested that a number of other aspects of speech might also change when IWPD work solely on increasing loudness. For example, Dromey and colleagues noted improvement in articulation as indicated by acoustic data on vowel characteristics and second formant trajectories following completion of LSVT® (Dromey et al., 1995). Similarly, a reduction in perceived hoarseness and breathiness in IWPD following completion of LSVT® has also been documented (Baumgartner et al., 2001). However, in the current study, there was no significant change in the ratings that participants offered for hoarseness, monotony, intelligibility, tremor, or participation in conversation. The lack of change in these parameters is in contrast to changes in similar features reported in other studies of group therapy for IWPD. For example, de Angelis et al. (1997) reported significant improvements in self-rated intelligibility, monotony, and strained-strangled voice quality. Robertson and Thomson (1984) did not report details of the assessment procedure in their group therapy investigation of

IWPD, but did note improvements in phonation, articulation, and prosody at the end of the group treatment regimen. Sullivan and colleagues (1996) suggested that group speech treatment was effective for improving speech intelligibility.

Perhaps the simplest explanation for the change in only the loudness rating in the present study is that the group treatment only targeted increased loudness and not any of the other aspects of speech that were addressed on the self-rating measure. The group approach may be less effective than LSVT® at influencing other aspects of speech production; however, caution should be taken when discussing the group approach since the intensity of the current study (six total sessions) was so much less than LSVT® (16 total sessions). The reason for additional changes besides loudness following completion of one treatment program, but not the other, is not readily apparent. One possible explanation is that there is not as much talk-time in the group setting compared to the traditional LSVT® setting.

Although only the loudness rating was statistically significantly changed, each of the other five parameters did change in a direction suggesting improvement post-intervention when the ratings for the FtF and the TM subjects were considered together; however, it is clear from inspection of the pre- and post-treatment means for the FtF and TM groups that the FtF participants reported improvements on more of the parameters (all six in fact) than the TM participants. The TM participant ratings reflected improvements for three of the six (loudness, tremor, and monotony). The remaining three parameters were rated by the TM group as being worse following the intervention; this included ratings for hoarseness, intelligibility, and participation in

conversation. A lack of statistical power as indicated by the small partial eta squared values is one possible reason a difference in the self-ratings (except loudness) was not detected.

Possible reasons for a worsening of ratings in the TM group should be considered. Before doing so, one should not over-interpret this apparent difference in how the two groups responded on the self-rating scales prior to and after treatment. Recall that there were no statistically significant group differences between FtF and TM on any of the self-ratings and none of the Group x Time interaction effects were significant. With that caution in mind, however, a primary focus of this study was to evaluate whether FtF and TM service delivery results in similar outcomes. At a minimum, the discrepancies in the direction of change on the ratings from the two groups raise the possibility that the TM individuals have less positive outcomes from the patient's perspective. One possibility to consider is whether some members of the TM group had a worsening of their PD over the six-week time period of the study, although this seems unlikely. None of the participants volunteered information during the course of the study or at its conclusion that their PD had substantially worsened. Additionally, neither the student clinicians nor the SLP supervisors noted any substantial change in behaviors or abilities consistent with a substantial worsening of the disease. Also, PD does not typically present with rapid disease progression in most cases, so it seems unlikely that there would be a noticeable change within six weeks.

A second explanation for the worsening of ratings for the TM group is that some members of the TM group may have substantially altered their internal referent for how severe they perceived their speech/communication to be as a function of participating in the treatment and/or from being around other participants with PD on a regular basis. That is, at the pre-data collection session they may have rated themselves as having fairly limited problems or difficulties, but once they focused on their communication for six weeks and had a chance to see a range of speech abilities from other members in the group, they may have altered how they perceived themselves on any given parameter. In future studies, providing the participants with their pre-treatment ratings should be considered. It may have been the case that some individuals shifted their use of the rating scales from pre- to post-treatment and provision of the earlier rating may help in that regard. Additionally, there were some individuals in the TM group who rated themselves pre-treatment as having no deficit (a rating of 0) on some scales; this did not happen for any of the 16 FtF participants. Interestingly, those TM participants who rated themselves pre-treatment as having no deficit on a particular speech parameter always rated themselves as having a deficit on the parameter post-treatment. It is possible that a participant may simply have misunderstood how the scale was to be completed at the first data collection session, although an investigator was always present with them as they filled out the scales and this did not seem to be the case. Finally, it may have been the case that ratings were taken on either a particularly "good" day pre-treatment or perhaps a "bad" day post-treatment for some individuals. Participants were asked to consider how they

have performed over the past several days when they responded on the self-rating scales, but it is not possible to know whether they really did so or not.

*Pre- to Post-Treatment Changes in VHI Scores*

The statistical analysis indicated that the *VHI* score did not change from pre- to post-treatment, even though the percent improvement in *VHI* score was slightly over 20% for the FtF and TM groups combined. The lack of a statistically significant change at the post-recording was somewhat surprising given 20% change and the comments from participants on the post-treatment questionnaire that suggested they felt the group was beneficial. A lack of statistical power as indicated by the small partial eta squared value is one possible reason that a difference was not found.

Although the FtF and TM groups did not differ statistically on their *VHI* scores, the group means suggest a difference that seems clinically relevant. The FtF group had a notable improvement on the *VHI* (28%) suggesting that they perceived some change in the degree of voice handicap even though this did not reach statistical significance. The percent change in *VHI* score for the FtF participants in the current study is comparable to prior research findings with IWPD who completed LSVT®. Spielman et al. (2007) reported a 25% decrease in *VHI* Total score (i.e., less perceived handicap) in a group of IWPD who completed an extended version of LSVT® (known as LSVT-X).

The *VHI* mean scores for the TM group were essentially unchanged from pre- to post-treatment. There is not a ready explanation for this lack of change. One possible explanation could be related to memory problems for the TM group. The TM

group may not have remembered how they filled out the pre-treatment form when they were completing the post-treatment form. In future studies, providing the individuals with their pre-treatment ratings should be considered. It does appear that the TM group started off at the pre-treatment recording with a notably lower (indicating less impairment) mean *VHI* score than the FtF group, although statistically there was no difference between the groups at either recording time. This lower *VHI* score for the TM group at the onset of the study (and lower self-ratings on five of six participant self-rating scales) supports the notion that the TM group may have been less impaired in terms of the voice compared to the FtF group at the start of the study, at least based on self-report measures. It may be that the outcomes of the voice group intervention are dependent on the degree of voice involvement at the start of therapy. Those who see themselves as having more voice trouble may truly experience greater benefit from the group which is then reflected in self-report measures. Alternatively, they may simply report greater voice benefit, regardless of whether the voice changed substantially as a function of the intervention.

Looking at the data for individual TM participants, there is no clear pattern or relation between *VHI* scores and the other measures of interest in this study. For example, one TM speaker who reported greater voice handicap after the group intervention also reported a worsening in five of the six self-ratings and no change in the loudness self-rating, but had a 6.3 dB increase in intensity. Perhaps an increase in intensity was not the particular kind of improvement or change that this person needed to facilitate his/her communication. Two other participants in the TM group

presented with a similar pattern (dB increased but worse *VHI* scores and worse self-ratings for a majority of the self-ratings); however, there were others in the TM group who presented differently. For example, a few TM participants showed no change in *VHI* score, but substantial improvement in the self-rating of loudness, an increase in dB, and scattered improvement on the other self-ratings. Still others had an improvement in *VHI* score, dB, and loudness ratings, but worsening on all other self-ratings. The divergent profile of results across participants may simply reflect a multi-factorial situation in which a person's rating of the degree of voice handicap and his/her self-ratings of other speech parameters is influenced by many factors, not just a change in dB. For some individuals, increasing dB to the extent that it was in this study may not have been sufficient to effect a change in more global ratings of speech, voice, or handicap. Of course, alternative explanations for the lack of change in *VHI* scores for the TM group should also be considered. These are essentially the same as those noted above for the self-ratings (i.e., worsening of PD during the study, individual speakers recalibrating how they view themselves once they are in the group, misunderstanding of the scales or items on the scales, idiosyncratic outcome of catching a person on a day when his/her speech was particularly good or particularly bad).

*Limitations and Future Directions*

There are several limitations of the current study, many of which have been identified in the discussion above. The most obvious, and perhaps most significant limitation, is that the subject groups were fairly small, particularly the TM group.

Increasing the size of the groups would not only increase statistical power for identifying differences across groups, but it would also allow the possibility of subdividing the groups into potentially relevant categories to look for variables that might influence group treatment outcomes. For example, stratifying the groups according to PD disease severity, degree of voice impairment, age, gender, and so forth, all may be helpful in future studies attempting to determine if the intervention is effective and for whom it is effective.

Although the treatment sessions were designed to elicit frequent responses from group participants, detailed information about the extent of participation or voice usage during the sessions was not gathered. The LSVT® program is designed to get a high response rate from a client within a given session, although the specific number of responses has not been stated in descriptions of LSVT®. Frequent use of a louder voice is believed to be critical to the success of LSVT®. Within the group setting, it is possible that an individual may have less opportunity to respond compared to individuals enrolled in LSVT ® or an individual in the group may chose not to respond. Ideally, the graduate student clinicians or SLP supervisor would notice a “non-responder” in the group and would promptly re-engage him/her in the group; however, it is also possible that within the group, a person may appear to be responding with the target voice (i.e., louder), but it may be difficult for the clinicians to judge whether an individual voice within the group response was truly as loud as desired. That is, an individual may be responding but not in a loud voice. Future studies will need to consider these details and possibly manipulate them in order to

gauge the relative importance of these features of the group process. Preliminary data regarding frequency of responding and total time spent talking in the group have been gathered on groups run following termination of the data collection for the present study. Briefly, several graduate students have visited the FtF group and observed individual participants to measure how much talking they do during the 90-minute session. Using a handheld stopwatch, the mean duration of talking within a session was ~10 minutes (n = 13 participants observed over five sessions). In a second round of data collection, a tally was made of the number of responses made by individual participants in the FtF setting. The mean number of responses in a session was 254, or 2.82 responses per minute. These data have not been analyzed in terms of relation to any of the other variables considered in the current study. Information on the TM group has not yet been gathered.

Different student clinicians were used for each six-week treatment session. This may be another variable that should be considered in future studies. It may be that more experienced clinicians operate the group differently, perhaps with differing outcomes. Greater consistency in the leaders of the group would have helped control the possibility that a particular six-week session was conducted differently than others. Constancy in the SLP supervisor provided some measure of control over the way sessions were run and the quality of the treatment; however, some graduate clinicians are stronger than others, and one six-week session may have been conducted more efficiently and with better outcomes. The number of subjects drawn from each six-week block was relatively small, precluding a statistical comparison of

outcomes from one six-week session compared to another. Despite the introduction of possible differences in groups related to change over in graduate student clinicians, this situation of changing clinicians does make it all the more impressive that significant changes in loudness and perceived loudness were found. There is a certain level of ecological validity to allowing different clinicians to lead the groups as this parallels to some extent the situation in which different certified SLPs carry out any other type of treatment within the field.

Data regarding listeners' perceptions of the participants' voices before and after treatment have not been gathered. More specifically, while the participants themselves indicated they were louder after treatment, it is not known whether independent and less biased listeners would report the same. The recordings for such a study are available and plans are underway to gather this information. In addition to having listeners' judge loudness, it will be important also to rate other aspects of speech and voice such as the degree of hoarseness, tremor, monotony, and so forth because of the unexpected outcome in the TM group where mean participant self-ratings suggested a worsening on some parameters after the treatment was completed.

The current study only gathered voice recordings one-day to two weeks after participants completed the intervention. Future studies should assess outcomes over a longer time frame to determine whether the gains in dB, self-rated loudness, and perhaps other parameters are retained beyond the first few weeks after the conclusion of treatment.

Finally, this study does not provide any information about whether the dB increase noted at the post-intervention recording is truly reflective of the intensity a participant uses in his/her daily communication. It is possible that the majority of participants increased their dB during the recording (particularly post-intervention) because they know they can and they know that has been focused on for the prior six weeks in therapy; however, outside the presence of the clinic, clinicians, and recording equipment, an individual may not utilize a greater vocal intensity. Carefully designed studies that allow sampling of dB throughout an individual's day would be ideal to address this issue (possibly utilizing newly available vocal monitors), but also reports from daily communication partners who are trained to the perceptual task could also be helpful in this regard.

*Conclusions*

Overall, the results of this study support the short-term effectiveness for improving vocal intensity in IWPD following group speech treatment. Improvements in dB were found for participants in both the FtF and the TM groups. The documented changes in dB were approximately half of the dB increase reported for individuals undergoing LSVT®, with differences in the schedule and intensity of treatment offered as the most likely explanation for the smaller dB change reported here. Paralleling the measured change in dB, participants in both groups rated themselves as being louder following completion of the treatment. These two findings (increased dB and perception of voice as louder), along with the anecdotal reports of treatment effectiveness from participants and families, are encouraging from a

clinical perspective. It would appear that group therapy using the schedule and focus of intervention described here holds promise for increasing the loudness of an IWPD regardless of whether the intervention is delivered FtF or via TM.

The *VHI* and participant self-rating data for the FtF group showed changes in a positive direction even though the changes were not statistically significant due to a lack of statistical power as indicated by the small partial eta squared value. This trend for positive change in the *VHI* and other self-rating parameters, when combined with significant increases in dB and self-rated loudness, is also encouraging in terms of using the group speech therapy in the FtF format. The *VHI* and self-report data for the TM group format are less positive, with limited change, no change, or in some instances worsening of self-perceptions of voice and communication following the treatment. Differences in the perception of voice and communication abilities at the start of the study, a shifting in the use of the scale or a recalibration of how severe an individual perceived him/herself at the end of the study, possible memory problems, and a change in disease state were some of the possible reasons offered for the lack of change or a worsening of perceptions in the TM group after completion of the group therapy. Additional work will be needed to more carefully delineate the effectiveness of the TM group and to identify relevant variables influencing outcomes when using this format.

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Appendix A

Lesson Plan

Parkinson's Speech Group
Fall 2006
Meeting: October 20, 2006
Supervisor: Karen Haring
Student Clinicians: Kiley Miller, Shannon Rogers, and Kristel Wilson
Theme: Happy Halloween

**GREETINGS:**

1. State goals and agenda/theme for the day.
    - Goals- Use strong and precise speech
      THINK LOUD!!
    - Theme- Happy Halloween
    - Agenda- Warm-up, activities, homework, and cool-down exercises
2. Discuss homework.

**WARM-UP**

1. "Do what I do" "Ah" for 5 seconds
2. 15 "Ahs" for 5 seconds with 2nd clinician counting number of times
3. Inhale; glide from a mid to high pitch; hold for 3 seconds
4. Do 10 times with 2nd clinician counting number of times
5. Inhale; glide from a mid to a low pitch; hold 3 seconds
6. Do 10 times with 2nd clinician counting number of times
7. Functional phrases; do 3 times; PowerPoint
8. Functional sentences; do 3 times; PowerPoint

**ACTIVITIES**

During activities which allow any person to respond, we will go around the circle to ask individuals the questions for the activities.

1. Hangman-a member of the group will pick a letter that they think might be in the word. If they get the letter correct then we will add the letter to one of the blanks below the hangman. If they do not get the letter correct then we will draw part of the hangman.
2. Halloween Mix 'n' Match- There will be two columns of words (5 on each side) and when a group member puts the two correct words together we will draw a line connecting them together. We will have the group repeat the word 2 times.

**Interim Energizer-** Say "Ah" loudly and clearly for 5 seconds 5 times with 2nd clinician counting number of times

3. Crossword Puzzle-We will read the question to the group, and a member will try and guess what the answer is. When the member gets the correct answer, then we will write it in on the crossword puzzle. We will have the group repeat the answer 2 times.
4. Ghost Bingo- We will supply the group members with bingo cards and candy corn to put on the spaces that we call. We will first have the group repeat the word that we draw. If an individual has that word, then they will repeat it alone in a longer phrase (e.g. I have a ghost).

**Interim Energizer**- Say "Ah" loudly and clearly for 5 seconds 5 times with 2nd clinician counting number of times

5. Trivia-we will have 12 Halloween trivia questions for the group. We will go around the circle to ask an individual if they know the answer. We will have that individual say the answer, and then repeat it as a group 2 times.
6. Jokes- We will ask a group member if they know the answer to the joke. Then we will repeat it 2 times as a group.
7. Superstitions-We will have a group member read the superstition and then repeat it as a group 1 time.

**DISCUSSION/CLOSING**

1. Questions???? Make sure everyone is comfortable with the homework procedure.
2. Final energizer
    - Loud "Ah" 5 times for 5 seconds with 2nd clinician counting number of times
    - 10 functional phrases with 2nd clinician counting number of times

Appendix B

Speaker Questionnaire: Pre-Therapy

**Please fill out this questionnaire to the best of your ability prior to the pre-therapy voice recording that will be done the 1-2 weeks before the start of the group therapy. Be as specific as you can in your answers. Fill free to use the back of the form or another sheet of paper if you need more room. If you do not understand a question, one of the investigators (Either Jeff Searl or Karen Haring) will be available during the Pre-Therapy Voice Recording session to help you complete any unfinished portions of this questionnaire.**

**Identifying Information**

Name: _____

Birth date: _____

Male or Female?

**Neurological and Other Medical Information**

Neurological Diagnosis/Stage: _____

Date of Initial Diagnosis: _____

Date of when symptoms were first noted: _____

What were your initial symptoms of Parkinson disease or Parkinsonism?

_____

_____

What are your current symptoms of Parkinson disease or Parkinsonism?

_____

_____

Do you have any tremor? Yes ___ No ___ If yes, please describe:

_____

_____

Do you have any other medical problems? Yes ___ No ___ If yes, please describe:

_____

**Medication Information:**

Medication(s) for Parkinson disease:

_____

How is it helpful?

_____

_____

Does your Parkinson medication affect your voice or speech? Yes ___ No ___
If yes, please describe:

_____

_____

Do you experience "on/off" symptoms? Yes ___ No ___ If yes, please describe:

_____

_____

Do you experience dyskinesia: Yes ___ No ___ If yes, please describe:

_____

_____

Other medications and conditions for which they are taken:

_____

_____

**Surgical Information**:

Have you had neurosurgery (deep brain stimulator implant, pallidotomy, or other procedures) to help with your Parkinson disease? If yes, what procedure, when, where, by whom?

_____

_____

If you have had some type of neurosurgery, did it help with your Parkinson disease symptoms? If yes, please explain. Please specifically comment on whether your speech or voice was affected.

_____

_____

Have you had any surgery on your larynx (or voice box)? If yes, explain what was done and why it was done.

_____

If you have had surgery on your larynx, how was your voice/speech affected?

_____

_____

**Speech Symptoms:**

Have you ever used your voice professionally (i.e., radio, television, acting, singing, etc.)? Yes__ No__ If yes, please describe:

_____

When did you first start to notice communication symptoms (i.e., changes in your speech and/or voice) that you associate with Parkinson disease?

_____

_____

What are your current voice/speech symptoms?

_____

_____

What is your **most significant problem** communicating today?

_____

_____

How do you typically use your voice during the day? What types of activities do you do that require your voice?

_____

_____

How many hours of speaking do you do in a day?

_____

Do people ask you to repeat?

_____

What do you do when you want to be as easy to understand as possible?

_____

_____

What percent of your speech do you think is intelligible (how much do people understand you)? ____%
Has Parkinson disease caused you to talk less? _____
How much less? _____

Why has Parkinson disease caused you to talk less?

_____

_____

Do you think you run out of breath during speech?

_____

Is it difficult for you to take a deep breath?

_____

Have you noticed if your voice is monotone in pitch?

_____

Is your **speaking** voice higher or lower in pitch compared to before your diagnosis of Parkinson disease?

_____

Have you noticed pitch breaks in your voice?

_____

Have you noticed changes in your singing voice? If yes, please describe.

_____

_____

Have you noticed changes in the quality of your voice (i.e., is it hoarse, breathy, etc.)? If yes, please describe the changes you have noticed in quality.

_____

_____

Have you noticed changes in the steadiness of your voice?

_____

Does your voice feel fatigued at the end of the day?

_____

Have you noticed if your voice is reduced in loudness?

_____

Have you noticed any slurring or mumbling in your speech?

_____

Has the rate of your speech changed? Faster or slower?

_____

Have you noticed any stuttering if your speech?

_____

Do you think your voice sounds nasal?

_____

Have you previously had speech treatment?

_____

If yes, describe the treatment. How long ago did you have speech treatment?

_____

How long were you in speech treatment (how many sessions, how many days/weeks, how long were the sessions)?

_____

Was this done one-on-one or in a group therapy setting?

_____

What types of things did you work on in the speech therapy?

_____

Was your previous speech treatment beneficial? Please explain.

_____

_____

**Swallowing Information**:

Have you noticed any problems with eating, chewing, and/or swallowing?

_____

If yes, please describe (types of foods, frequency or problem, etc.)

_____

_____

Have you noticed any change in taste or smell? If yes, what type of change?

_____

_____

**Neuropsychological Information**

Have you noticed any difficulty with your memory, problem solving, or ability to focus on a task? Please describe.

_____

Does your medication affect your memory? If yes, how does it affect your memory?

_____

_____

What aspect of your Parkinson disease bothers you the most?

_____

_____

Appendix C

*Voice Handicap Index (VHI)*

**Name: _____**
**Date: _____**

INSTRUCTIONS: These are statements that many people have used to describe their voices and the effects of their voices on their lives. Check the response that indicates how frequently you have the same experience.

| | | **Never** | **Almost Never** | **Sometimes** | **Almost Always** | **Always** |
|---|---|---|---|---|---|---|
| 1. | **My voice makes it difficult for people to hear me.** | | | | | |
| 2. | **I run out of air when I talk.** | | | | | |
| 3. | **People have difficulty understanding me in a noisy room.** | | | | | |
| 4. | **The sound of my voice varies throughout the day.** | | | | | |
| 5. | **My family has difficulty hearing me when I call them throughout the house.** | | | | | |
| 6. | **I use the phone less often than I would like.** | | | | | |
| 7. | **I'm teased when talking with others because of my voice.** | | | | | |
| 8. | **I tend to avoid groups of people because of my voice.** | | | | | |
| 9. | **People seem irritated with my voice.** | | | | | |
| 10. | **People ask, "What's wrong with your voice?"** | | | | | |
| 11. | **I speak with friends, neighbors or relatives less often because of my voice.** | | | | | |

| | | Never | Almost Never | Sometimes | Almost Always | Always |
|---|---|---|---|---|---|---|
| 12. | **People ask me to repeat myself when speaking face-to-face.** | | | | | |
| 13. | **My voice sounds creaky and dry.** | | | | | |
| 14. | **I feel as though I have to strain to produce voice.** | | | | | |
| 15. | **I find other people don't understand my voice problem.** | | | | | |
| 16. | **My voice difficulties restrict my personal and social life.** | | | | | |
| 17. | **The clarity of my voice is unpredictable.** | | | | | |
| 18. | **I try to change my voice to sound different.** | | | | | |
| 19. | **I feel left out of conversations because of my voice.** | | | | | |
| 20. | **I use a great deal of effort to speak.** | | | | | |
| 21. | **My voice is worse in the evening.** | | | | | |
| 22. | **My voice problem causes me to lose income.** | | | | | |
| 23. | **My voice problem upsets me.** | | | | | |
| 24. | **I am less out-going because of my voice problem.** | | | | | |
| 25. | **My voice problem makes me feel handicapped.** | | | | | |
| 26. | **My voice "gives out" on me in the middle of speaking.** | | | | | |
| 27. | **I feel annoyed when people ask me to repeat.** | | | | | |
| 28. | **I feel embarrassed when people ask me to repeat.** | | | | | |

| | | Never | Almost Never | Sometimes | Almost Always | Always |
|---|---|---|---|---|---|---|
| 29. | **My voice makes me feel incompetent.** | | | | | |
| 30. | **I'm ashamed of my voice problem.** | | | | | |

Please circle the word that matches how your voice feels today:

Normal Mild Moderate Severe

P Scale _____ F Scale _____ E Scale _____ Total _____

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Appendix D

Perceptual Rating Form - Speakers

**Name: _____ Date: _____**

**Please use a pen or pencil to mark the place on the line that best represents your typical speech:**

Always loud enough Never loud

_____

Never a “shaky” voice Always a “shaky” voice

_____

Never a hoarse “scratchy” voice Always a hoarse “scratchy” voice

_____

Never monotone Always monotone

_____

Never slurs Always Slurs

_____

Never a “strained” voice Always a “strained” voice

_____

Never mumbles Always mumbles

_____

Always speaks so others understand Never speaks so others understand

_____

Always participates in a conversation Never participates in a conversation

_____

Always starts a conversation Never starts a conversation

_____

Appendix E

Speaker Questionnaire: Post-Therapy

**Please fill out this questionnaire to the best of your ability after the last group therapy meeting. Be as specific as you can in your answers. Fill free to use the back of the form or another sheet of paper if you need more room. If you do not understand a question, one of the investigators (Either Jeff Searl or Karen Haring) can help answer your questions (they can be reached at 913-588-5937).**

**Identifying Information**

Name: _____

Birth date: _____

Male or Female?

**Voice and Speech Information**

Since you completed the group speech treatment, have you noticed changes in your speech and/or voice?

_____

_____

If yes, please describe those changes. _____

_____

Have other people commented that it is easier to understand you **now**?

_____

_____

What have they said? _____

_____

Have people made any other comments regarding your voice, speech, or communication? Give examples of what they have said.

_____

Do people ask you to repeat? _____

Do people have a hard time understanding you? _____

What do you do when you want to be understood? _____

_____

How often do you do that? _____

Does it work? _____

Do you do more talking since you started or completed treatment? _____

How much more? _____

Why? _____

_____

What percent of your speech do you think is intelligible (i.e., people can understand you)? _____

Have you been practicing? _____

How often? _____

What do you do when you practice? _____

Does it help? _____

**Medical Status and Medication**

Have you had any major medical changes since beginning the group speech therapy?

_____

_____

Have you had any change in your medication since beginning the group speech therapy?

_____

_____

**Your Thoughts on the Therapy**

What did you think was the main focus of the group speech therapy? (i.e., what was the therapy trying to get you to do?) _____

_____

Was the speech therapy program effective? _____

What were your favorite things about the speech therapy program? _____

_____

What did you not like about the speech therapy program? _____

_____

What changes would you recommend be made for the next time that the speech therapy program is offered? _____

_____